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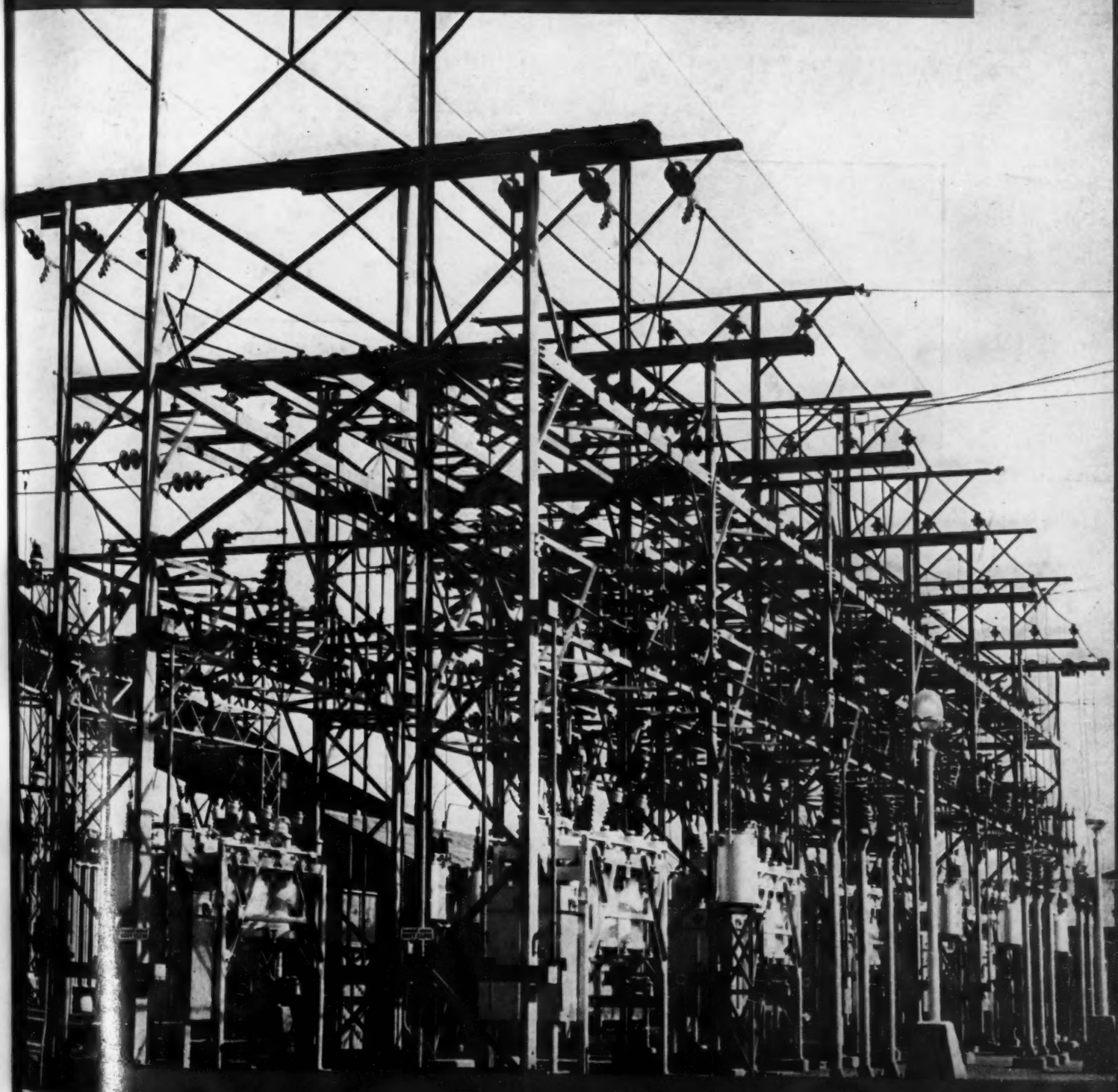
Electrical World

FEBRUARY 21, 1942



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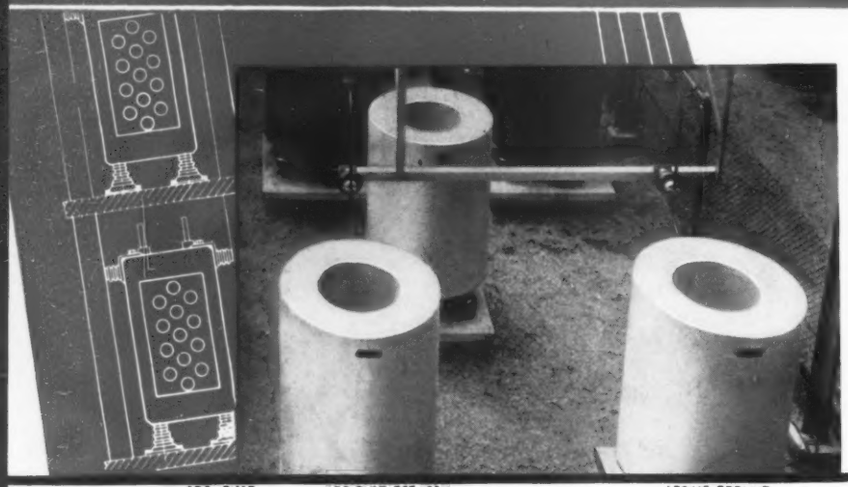
requires

★ MAXIMUM FREEDOM ★

FROM AVOIDABLE

★ POWERFLOW INTERRUPTIONS ★



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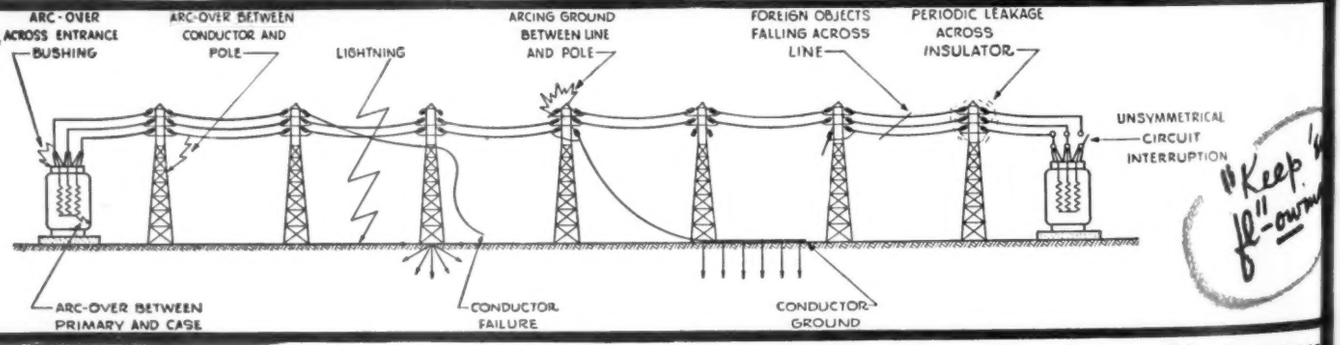

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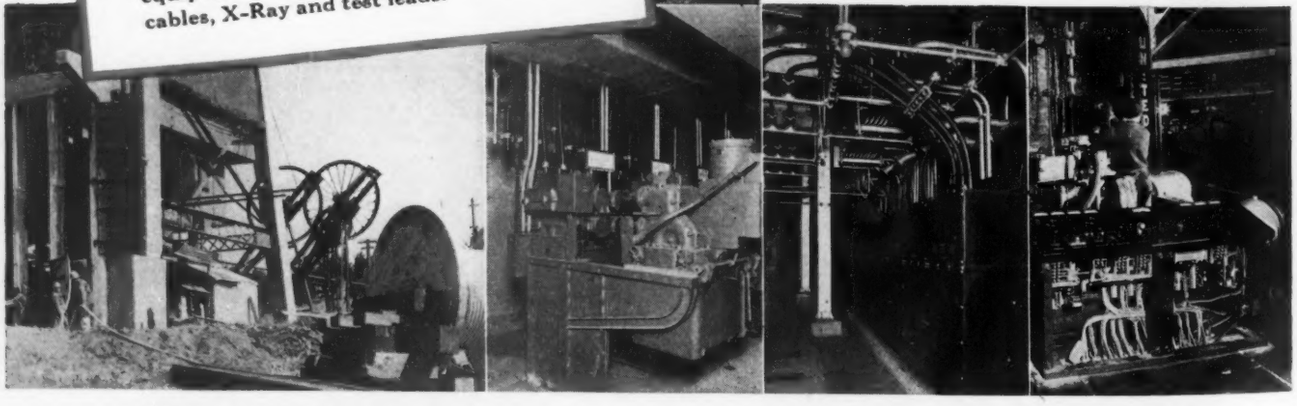


OKONITE INSULATED WIRES AND CABLES

Quality of Management

A division head of WPB said recently that the big bottleneck of the whole war effort was the quality of management. He was referring to critical materials, but in our opinion he might just as easily have said that without good management in military and naval operations, in government, in industry we will lose this war.

To criticise the armed forces effectively requires a knowledge of war strategy which we do not possess, but we know that the quality of management in the field means the difference between Pearl Harbor and Corregidor.

On the home front one is better able to make an appraisal and, regrettably enough, there still seems to be a disposition to try to keep from giving up personal objectives and prejudices, regardless of their effect upon the war. There are still a great many people, both in government and civilian life, who are blind to national welfare just so long as they can promote their immediate selfish ends.

It is to be regretted that the President, who has repeatedly urged the full sacrifice of the people, has not shown more leadership in insisting that personal political ambition, boondoggling and promotion of projects that cannot be claimed to be war necessities be stopped for the duration. It is little wonder that people have difficulty knowing whether the President is deliberately breaking the faith with his people, or, as some one said, is "too busy saving political faces to have time to kick hind ends."

That situation, however, will in time take care of itself at the polls. War mismanagement on the part of government quickly builds up an antagonistic electorate.

But management of business is not blameless. There are too many managements that are not thinking clearly at this time. There is too much disposition to argue over the terms of a project the government wants instead of getting the work done and arguing the terms later. There is too much wrangling and selfishness between concerns in a cooperative venture, such as a power pool. There is a disinclination to face the facts and act accordingly.

For instance, how many manufacturers of peace-time products have singly or cooperatively taken steps to get into war material production? Or how many utilities have plans for making replacements and for replacement training? Or for material salvage? Or for maintenance and employee problems in connection with longer hours of operation? Or for a sound sales program? Or for rate adjustment? Just to mention a few things.

There is too much holding back waiting for instructions from Washington, and then not liking the instructions. This is true whether it refers to price or production limitations for equipment or to transmission ties or power-rationing plans.

This is our war—not Washington's. No matter how much we may disapprove of New Deal policies and practices, we must not let our quality of management become atrophied. Unless business management is not as good as that of Washington, it is about time for the pressure to start coming from business rather than always coming from the capital.

The quality of management will determine the outcome of this war.

Chickasaw Electrical Design Influenced by Humidity

Mostly non-lead cables and drip-proof motors for station service — Outdoor instrument transformers indoors — Bare cable for 22-kv. bus — Three-winding station service transformer — Silver contacts — Air breaker cubicles

A. H. MERGENTHALER,* Commonwealth & Southern Corporation, Birmingham, Ala.

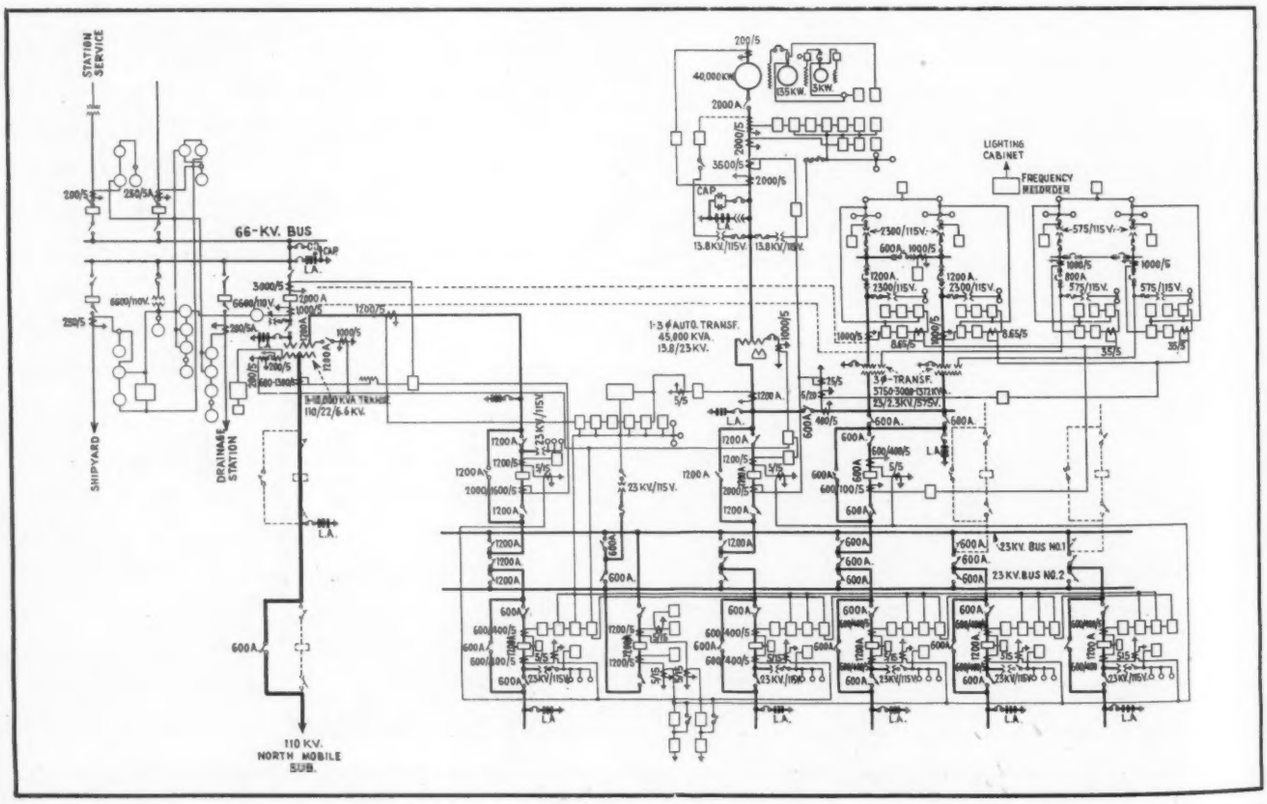
ELECTRICAL FEATURES of the Chickasaw plant comprise the following decisions: (1) a three-winding station service transformer, (2) bare copper cable for the 22-kv. bus, (3) silver contacts to avert the higher cost of over-rated switching equipment, (4) outdoor instrument transformers indoors to combat humidity, (5) air breaker cubicles for station service, (6) mostly non-leaded cables for station service and control. The steam-end design was described in "Chickasaw Plant Solved Unusual Condensing Problems" in ELECTRICAL WORLD, November 29, 1941.

Connections from the generator terminals to the transformer were made with copper busbars indoors and copper tubing outdoors.

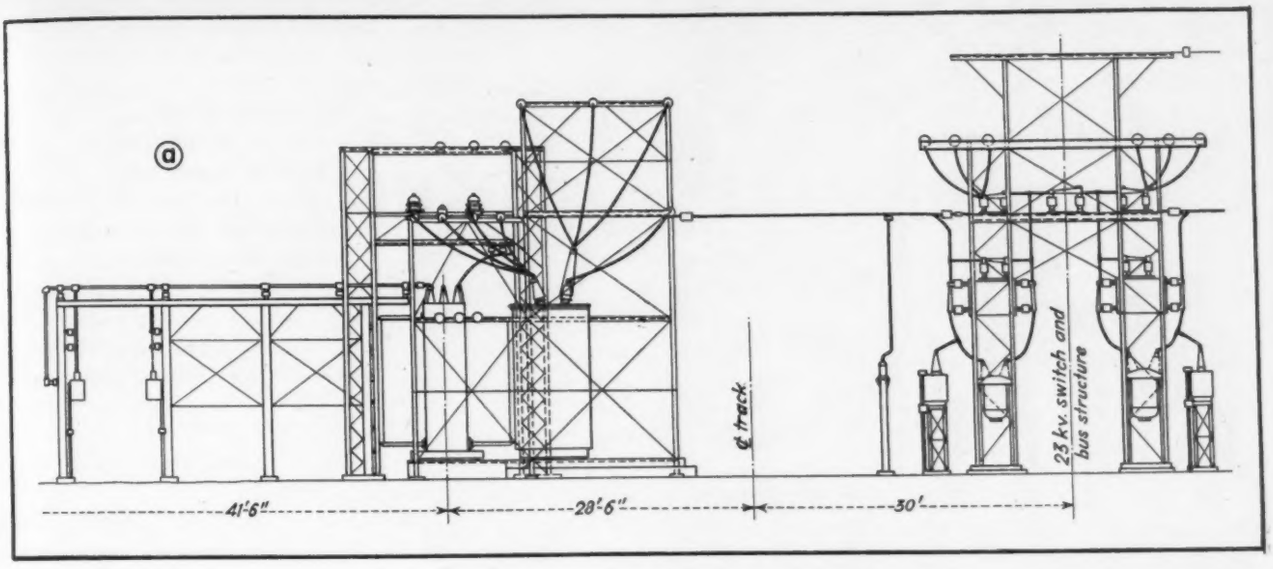
Generator voltage of 13.8 kv. is stepped up to 22 kv., which is the system voltage of the tie lines to the various distribution substations in the Mobile area, through a three-phase Moloney auto-transformer having a rating of 45,000 kva. forced air-cooled (33,750 kva. self-cooled). The second step of transformation is from 22 kv. to 110 kv., the high-tension system of the Alabama Power Company, by means of a 30,000-kva. transformer bank.

Two self-cooled, three-phase station service transformers (Moloney) have been provided (one intended to serve as a spare unit), having a rating of 3,750 kva., 23,000/2,300/575 volts each. It was found that the overall station service installation cost

*Electrical engineer.



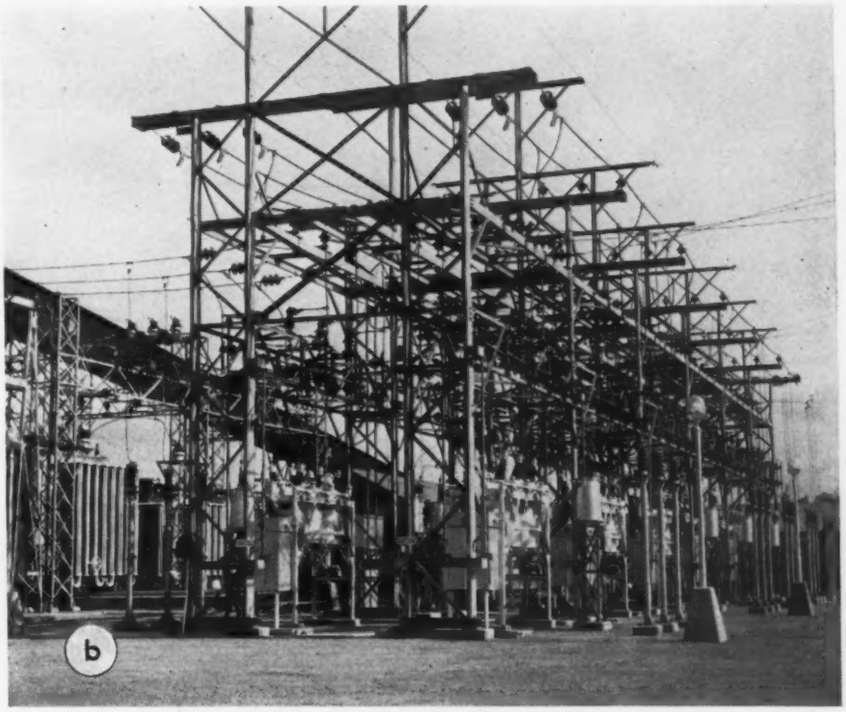
TWO STAGES of transformation, one to 22 kv. for the Mobile area and the other to 110 kv. for tie to the Alabama power transmission system



would be considerably lower with the three-winding transformers than a similar installation using two steps of transformation for the two station service voltages of 2,300 and 575.

The design of the 22-kv. substation is an interesting feature of the plant. The 22-kv. buses and connections consist of bare copper cable. This design has the advantage of a much lower initial installation cost than a comparable tubular bus layout, and in case of fire or flashover damage repairs and replacements can be made in a much shorter time than in case of a rigid bus installation. The currents to be handled by these buses are heavy, but they are still within the permissible limits of the application of a cable bus. Shielding wires have been provided over the main buses. Lightning arresters have been installed for the protection of the equipment in the substation on all the incoming lines and on all transformers.

A 110-kv. line, 5 miles long, interconnects this plant with the Alabama Power Company high-voltage system at the North Mobile transmission substation. The short distance of this 110-kv. line made it advantageous to apply pilot wire relay protection and to use only one 110-kv. breaker at the North Mobile transmission substation.



BARE COPPER CABLE used for 22-kv. bus. (a) Double bus with bus selector disconnecting switches and a double line pull-off per bay. Each bay is 22 ft. long. Buses are supported by pedestal insulators at 22-ft. intervals. (b) Structure designed and braced to withstand 120-mile wind; 45,000-kva. auto-transformer and one 3,750-kva. station service transformer in left background

Silver Contacts

Oil circuit breakers (Allis-Chalmers) connected to the 22-kv. bus have a voltage rating of 23 kv. and 34.5 kv. and a respective interrupting rating of 500,000 kva. and 1,000,000 kva. The breakers with the higher rating are feeder breakers which have reclosing relays applied to their control circuits. Due to the derating factor, which has to be considered in the selection of the breakers when applying reclosers, it was necessary to specify the next higher voltage class in order to stay within the required interrupting ratings. At times the equipment in the main leads to the 22-kv. bus and in the leads from the 22-kv. bus to the 30,000-kva. transformer bank will have to carry its rated current continuously. For this reason the breaker manufacturer was requested to equip the 1,200-amp. transformer breakers with main contacts, having silver inlay bridges, in addition to the arcing contacts. The disconnecting switch manufacturer was requested to equip the contacts of his disconnecting switches with silver inlay strips. Equipment for these heavy current-carrying circuits is designed to carry its full rated current continuously, without overheating, under any normal operating condition, thereby eliminat-

ing the usual practice of purchasing over-rated equipment at a much higher cost.

Station Power

In specifying the indoor equipment, consideration had to be given to the extreme condensation which takes place inside the building during certain atmospheric conditions and during shut-down periods. The instrument transformers, which are mounted indoors, were therefore specified to be of the outdoor type. Heaters have been provided in the large motors and in the inclosed electrical equipment in order to keep the air above the dew point during shut-down periods.

The station service power is distributed at 2,300 volts, 575 volts and 208 volts. The 208-volt power is being supplied by two Pyranol-filled, 150-kva. 575-208Y/120-volt, three-phase transformers mounted indoors. One of these serves as a spare transformer. The 120-volt connection is used for the lighting power supply. Motors rated above 100 hp. are connected to the 2,300-volt station service system. Motors with a rating of less than 100 hp. and more than 1 hp. are connected to the 575-volt bus. Motors of 1 hp. and smaller are being supplied through Westinghouse switchgear from the 208-volt bus. All motors (Crocker-Wheeler) are designed for "across-the-line" starting, are completely drip-proof and are of the 40 deg. C. rise temperature classification. Such motors will withstand a continuous overload of 10 or 15 percent of their rating in normal ambient temperature. The selected rating of each motor in this plant is therefore very close (plus or minus) to the actual requirements.

In order to have the greatest amount of flexibility under any operating condition on the station service system there have been provided dual power supplies to all station service groups.

Indoor Switchgear

Station service switchgear consists of air circuit breakers mounted in steel compartments. The 2,300-volt switchgear (I-T-E) is grouped into two sections with a bus sectionalizing breaker between the sections. It is possible to operate the plant with one of the 2,300-volt switchgear sections out of service. Design and maintenance of the switchgear has been simplified by providing only a single bus per section. This should prove entirely satisfactory in service, since the switchgear is of the metal-clad type and the buses and all connections are fully insulated. Breakers have an interrupting rating of 100,000 kva. and are of the withdrawal type.

The 575-volt switchgear (I-T-E) has been subdivided into three groups, which are all of the completely metal-inclosed type. There is a main group with breakers having an interrupting rating of 40,000 amp. The bus in the main group can be split into three sections. This will permit a quick restoration of service in case of any failure on the 575-volt system. Coal handling and lighting can be completely isolated in this group from the other station service sections. The two other 575-volt groups are the turbine room group and the boiler room group, one located in the turbine room and the other one on the boiler room operating floor. These groups are equipped with breakers having an interrupting rating of 20,000 amp. Breakers in the above 575-volt groups are of the withdrawal type.

For the coal-handling equipment there have been installed two 575-volt switchgear groups with rigidly mounted breakers having an interrupting rating from 10,000 to 20,000 amp., depending on the requirements. The selection of rigidly mounted breakers in this case is justified because this equipment can be taken out of service for several hours at a time for maintenance purposes.

Withdrawal type breakers of the 2,300-volt and 575-volt switchgear are provided with a test position in which the main separable contacts are disconnected, thereby isolating the breakers from line and load. The auxiliary control contact connections are, however, maintained in this position, which permits the electrical operation of a circuit breaker within its compartment for test purposes. In addition, there has been provided a clearance position beyond the test position in which both main and control circuits are disconnected. Provision for padlocking the breaker carriage in this clearance position has been made and shutters are provided in the 2,300-volt compartments between the breaker male and female contacts, which are closed when the breakers are in this position. It is also possible to lock the compartment doors while the breakers are in the clearance position. This required deeper compartments than are furnished with the conventional design. It has been considered important that clearance can be given for the outgoing feeders during maintenance work without having to remove the breakers from their compartments. This will prevent exposing them unnecessarily to dust and chemical fumes which are present in the boiler house.

The 2,300-volt station service system is connected in wye and grounded. Ground relays have been provided in addition to the overcurrent relays in order to prevent any ground fault from developing into a phase-to-phase fault on the larger motors and thereby prolong the repair period.

The 575-volt system is connected in wye, but is being operated ungrounded, mainly for economical reasons. It is expected that any ground fault on this system will result in less severe consequences than on the 2,300-volt system and that repairs or replacements can be made more easily than on the 2,300-volt equipment which consists entirely of essential circuits.

Station Cable

Special consideration had to be given to the selection of the cables due to the existing atmospheric conditions in the Mobile area. Based on the experience of the operating company over a period of twelve years, it had been decided to omit the lead covering wherever possible. With this requirement set forth, it was necessary to select an insulating material which is stable both in physical and electrical properties under wet service conditions. This insulating material also had to have resistance to the attack of such acids and alkalies as encountered in service in the Mobile district and high ozone resistance and low specific conductive capacity for the power circuits. On this basis the following cables were selected:

(a) For the 6,600-volt circuits indoors and outdoors—Kerite insulated cable with a conducting asbestos braid.

(b) For the 2,300-volt and 575-

volt circuits in the turbine room, in the condenser room, in the lower sections of the boiler house and outdoors—Okolite insulated cable with FRWP braid.

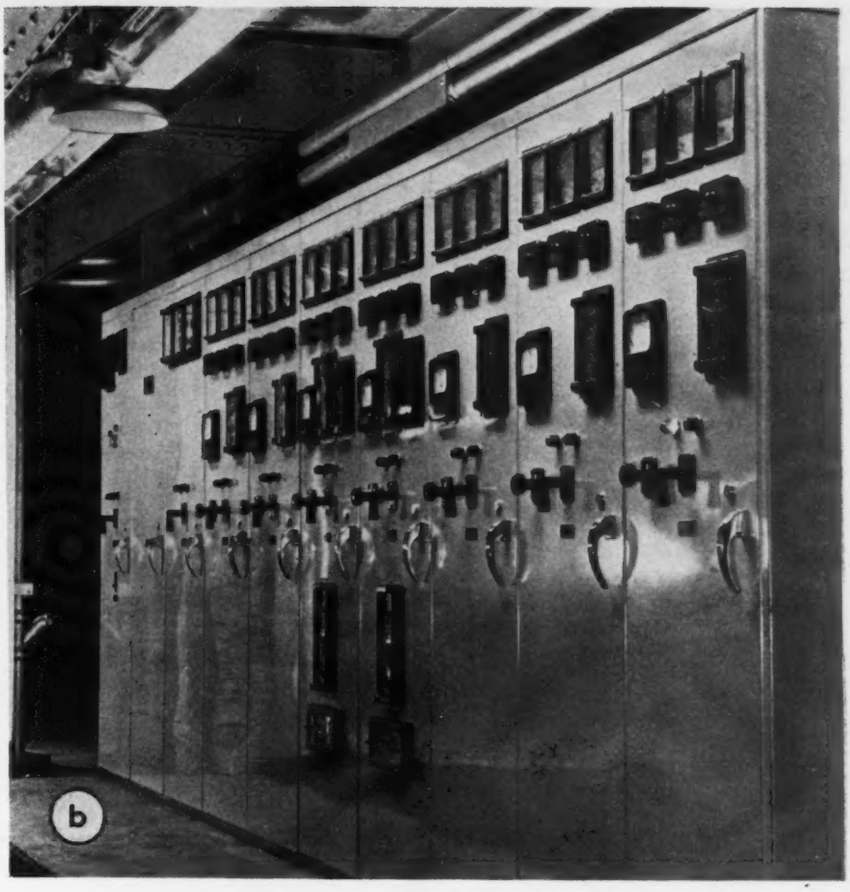
(c) For all control circuits indoors with the exception of the cables on the upper floors of the boiler house—Okolite insulated cable with glass braid.

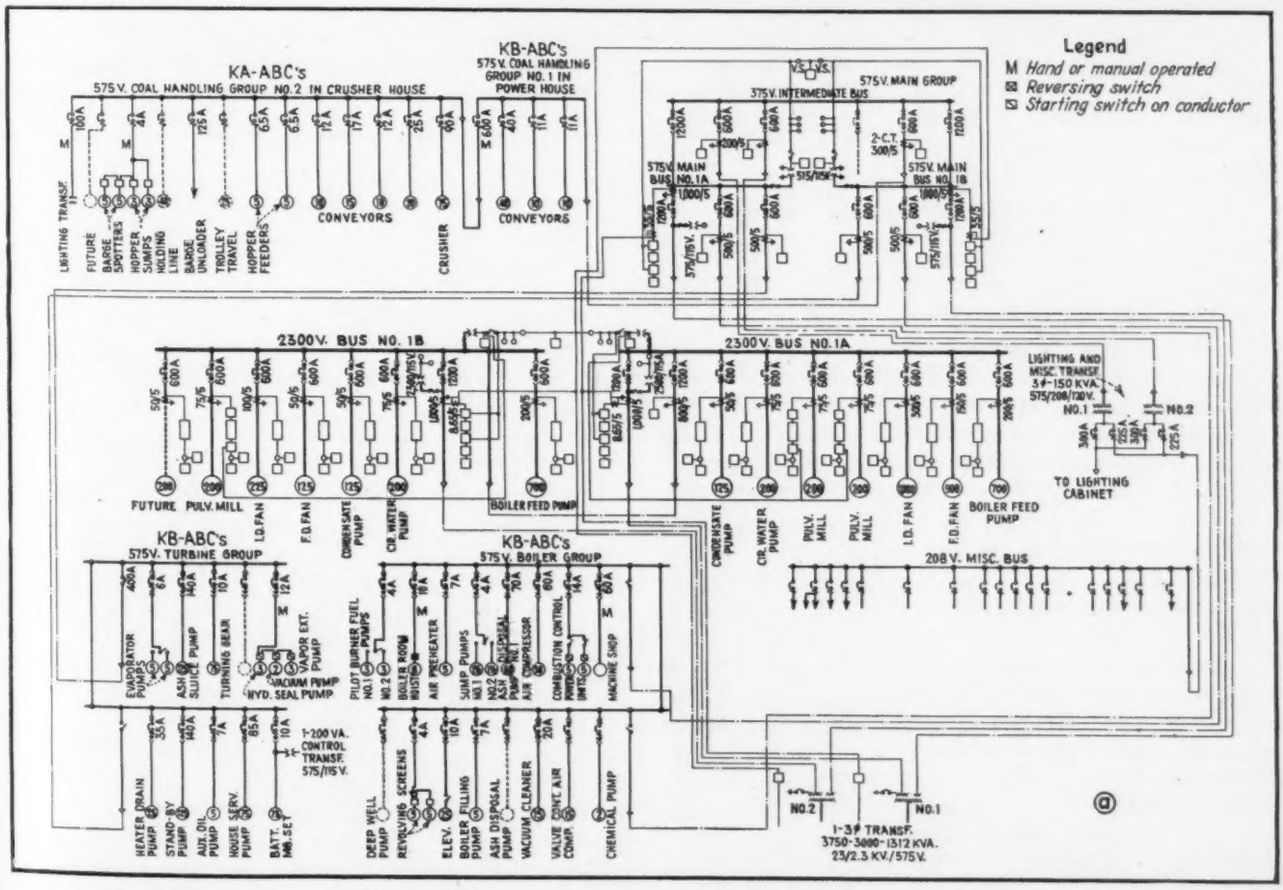
(d) For all indoor and outdoor lighting circuits with the exception of the circuits close to the boiler and the upper floors of the boiler house—Okolite insulated cable with FRWP braid.

(e) For all outdoor control circuits—rubber insulated cable with a rubber jacket.

(f) In the area of the boiler house, where the ambient temperature exceeds 45 deg. C., it was necessary to install asbestos varnished-cambric insulated, lead-covered cables for the power, the control and the lighting circuits.

(g) All power cables, including the 6,600-volt cables, are terminated without potheads outdoors as well as indoors.





THREE VOLTAGES (2,300, 575 and 208) used for station service. (a) All motors are started across the line with ratings chosen close to requirements. (b) Breakers in 2,300-volt station service switchgear sections are removable from rear of compartments

Power Design in Defense Plants IV—Electrical System Protection

Differential relaying supplemented by reverse power and overload protection predominate — use of fault bus limited — Seek to limit faults to smallest practicable plant area

HERMAN WINTE* *Albert Kahn Associated Architects & Engineers, Inc., Detroit, Mich.*

CONTINUITY of electric service, both as to supply and distribution, and the isolation of electrical disturbances to the smallest plant area practicable are objectives dominating design of electrical system protection for modern industrial plants engaged in wartime production.

Because of their physical sizes, the magnitudes of their electrical loads and the characters of their distribution systems, more attention is being given to relay protection of modern armament plants than has been given to relaying in most of their peacetime commercial counterparts in the past.

Protection system most widely employed in defense plants involves differential relaying with supplementary power-directional and over-current features. Extent to which differential protection is being carried into the plant differs widely from plant to plant. It depends on engineering economics modified by individual company preferred operating practices. In some cases differential protection is confined to the master substation alone. In others it is carried through the distribution system up to the factory substation secondary power bus.

Fault bus protection has been used in a few defense plants, notably a large aircraft plant; however, its use to date as an alternative to differential protection is confined to applications dictated by local power system circumstances.

There are four phases to the problem of protecting the electrical system of a large industrial plant from faults:

1. Maintenance of high-tension service to the plant through coordinated protection of the dual system of high-tension supply.
2. Protection of transformers, buses, bus structures, etc., in the master substation so as to remove the affected element from service as quickly as possible.
3. Correlation of breaker duty with load and feeder capacity to meet problems imposed by emergency interconnection of factory substation secondary buses.
4. Protection of load areas through coordination of short-circuit and overload protection of circuit elements from the factory substation feeder breaker to the driven machine.

Supply Circuit Protection

If any portion of a defense plant is to continue in operation following an internal electrical fault, high-tension power supply must be continuous. This implies that faults within the plant must be isolated in the plant and before they can affect the main supply line breakers. Similarly

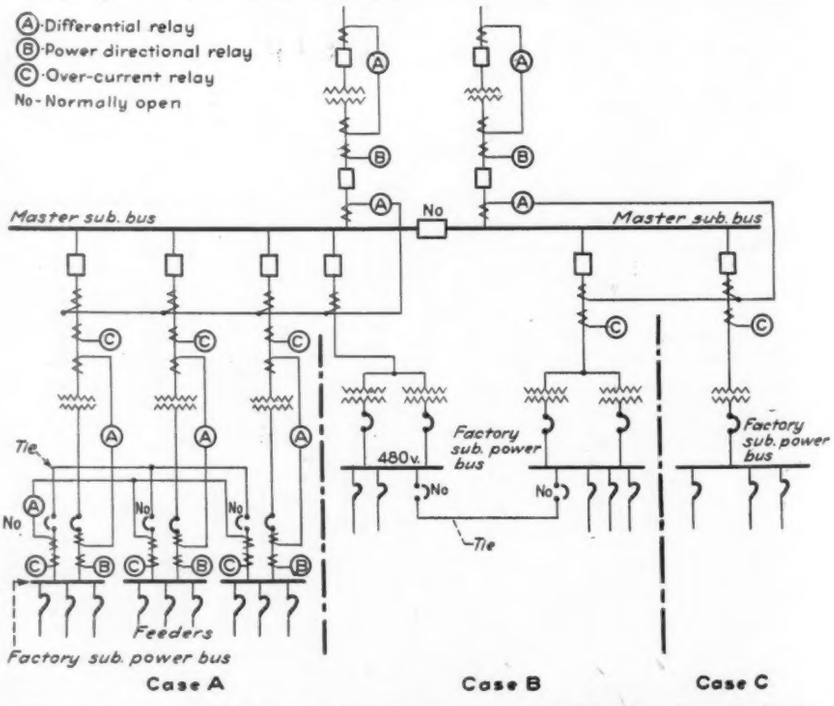


FIG. 1—Extent to which differential relaying is carried through system varies from plant to plant. Case A carries differential protection through to factory substation emergency interconnections. Where more than one factory substation power transformer is supplied by feeder, as Case B, differential protection is not used

*Electrical engineer.

sources of overload must be cut out of the system — internally — at the switching points nearest such sources.

If this is properly achieved through coordination of internal protection, high-tension protection at the point where transmission lines enter the plant is chiefly prescribed by the needs of the utility system to which it is connected.

This dictates: (1) That breakers on the plant end of the incoming high-tension supply line have short-circuit interrupting capacities sufficient to interrupt the utility system kva. at the industrial plant substation; (2) that through differential relaying or its equivalent these breakers shall operate to clear short circuits and ground faults in the main plant supply transformers and associated equipment from the point of connection to the utility system to the plant master substation, and (3) that reverse power relay protection be provided on each supply line to prevent one line feeding into a fault on the other system.

High-tension supply protection shown in Fig. 1 illustrates the method of protection used in a major number of defense plants. While the circuit shown is not that of any existing plant it is similar in principle to that employed in a bomber plant and an engine plant in the Middle West.

There is considered to be little need in industrial plants for fast switching speeds. Most of the breakers used have an interrupting time of 6 to 8 cycles. Distances and degree of interconnection involved in defense plant electrical systems are negligible compared to utility systems and for that reason the need for high-speed breakers to clear faults "instantly" is lacking.

In plant master substations differential relaying is the preferred method of protecting bus sections, transformers and associated equipment. The composite system diagram shown in Fig. 1 illustrates how it was applied to the master substation bus in a recently completed aircraft engine plant. Fault bus protection has been applied to one plant, dictated by local utility system circumstances.

In a differential system of bus protection current entering individual bus sections from main supply transformers, as shown in Fig. 1, is balanced against the sum of the currents leaving the bus section through feeder connections. A short circuit or ground fault will change the balance of incoming vs. outgoing current actuating a differential relay operating the bus supply breaker. Such an eventuality means loss of the entire bus load.

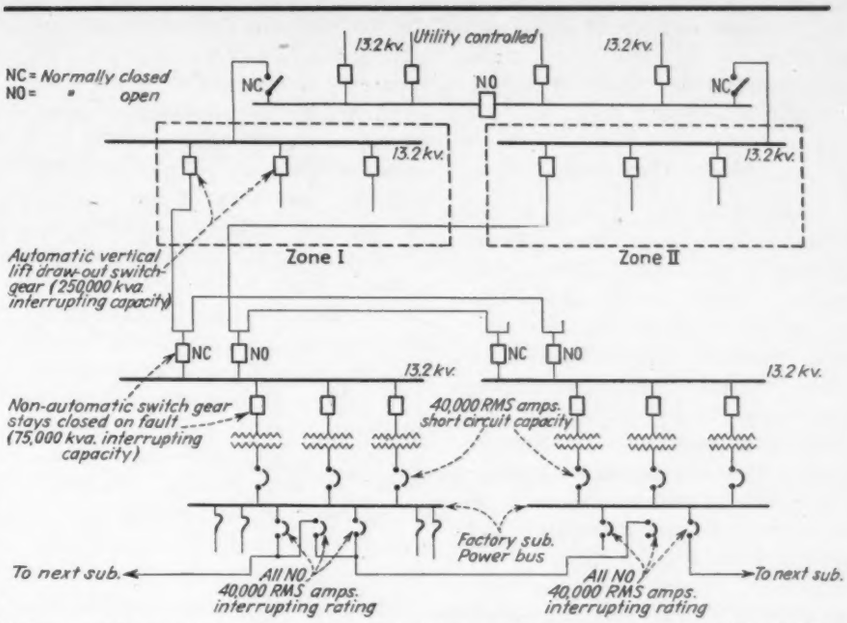

NC = Normally closed
NO = " open
13.2 kv.
Utility controlled
NC
NO
Zone I
Zone II
Automatic vertical lift draw-out switchgear (250,000 kva. interrupting capacity)
Non-automatic switch gear stays closed on fault (75,000 kva. interrupting capacity)
40,000 RMS amps. short circuit capacity
Factory sub. Power bus
To next sub.
All NO
40,000 RMS amps. interrupting rating
Zones I and II are isolated from system by fault bus protection system in event of bus fault

FIG. 2—Fault bus protection used in one defense plant to protect master substation bus was dictated by local power system circumstances

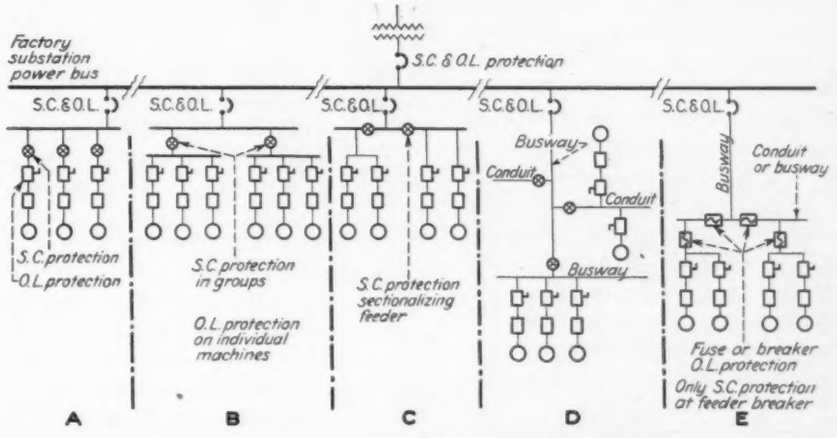


FIG. 3—For isolating faults in load areas protection must be located so as to shut down the economical minimum number of essential production machines. Cases illustrate typical locations for varying circumstances

In a fault bus system all bus structures, switchgear and equipment in the master substation are divided into fault zones. Equipment in each zone is insulated from building steel and connected to a section of the substation ground fault bus. Current transformers in each fault bus section detect variations in ground current caused by faults and act through relays to trip circuit breakers connecting the faulted zone to the rest of the system. Because of the cost of isolating all equipment from ground in an existing plant, this system is largely restricted to new plants. It is generally more costly than differential protection.

In the case of the fault bus protection system shown in Fig. 2, reliance is placed on instantaneous short-circuit characteristics of the master substation feeder breakers for isolation of faults in the feeders to the factory substation and in the factory substation 13.2-kv. bus. Non-automatic switchgear was used for bus feeder breakers at each substation (through them any factory substation 13.2-kv. bus could be supplied from either master substation 13.2 kv. bus) and also power transformer supply break-

ers. Reliance was placed on secondary breakers in each power transformer to interrupt faults in the factory substation power bus.

Feeder Protection

As shown in Fig. 1, case A, one large aircraft plant has extended differential protection, with supplementary reverse power and overcurrent protection, to factory substation power transformers and feeders and to the emergency ties between factory substations. This protection was provided in the emergency ties because under certain circumstances as many as five factory substations could be interconnected in an emergency and supplied from two or three factory substations. Under such a condition it is important to be able to separate all substations from each other in event of a fault in the tie circuit. The differential relay would trip all tie breakers in this event. These tie breakers are closed only when normal supply to one or more substations is interrupted.

Reverse power relays were also used in the main secondary connection to the factory 480-volt power bus in this bomber plant to prevent power from other substations flowing into a fault in the factory substation power transformer secondary. Overcurrent protection in the tie connection to the factory substation bus also prevents any one substation from drawing a disproportionate amount of power from ties in an emergency.

Differential protection of factory power transformers and feeders is limited to cases where there is only one power transformer per feeder. If differential protection was used where there are two or more transformers per feeder a short-circuit or ground fault in one unit would remove both the good and the faulted transformer. Reliance for short-circuit protection in such cases (Fig. 1, case B) is placed entirely on instantaneous short-circuit features of feeder, tie and transformer breakers.

Secondary Circuit Protection

The widespread practices of interconnecting factory substation secondary bus sections in defense plants during emergencies has brought about a change in the duty imposed on main transformer secondary (bus supply) breakers in the substation. Heretofore in straight radial systems without provision for interconnecting secondaries in emergencies (see Fig. 1, case C) it was the duty of the main secondary breaker to protect the main secondary feeder cables and buses against overload. Now, however, with the possibility of the load of two or more substations being imposed on a single factory substation or transformer, it becomes necessary for the main secondary breaker to be able to protect the transformer rather than the cable or bus from overload.

By proper proportioning of loads to feeder capacity shutdown due to overloaded bus or cable has been reduced to a minimum. Through arrangement of circuits transfer of load of any reasonable amount can be made from one circuit to another without danger of overloading copper.

Load Area Protection

In utility systems network practice is to permit secondary cable faults to "burn clear" without resorting to automatic sectionalization or other means of isolating the fault. In industrial plants, because system capacity is less and because of the danger of fire, facilities must be provided to isolate the fault. How and where this short-circuit protection is applied, however, is determined by the importance of the production area.

Protection provided must limit circuit disturbances to the economical minimum number of production machines—both from a production and from an investment standpoint. Cost of added protection must be balanced against loss of time and material to be avoided through its use. It would be obviously uneconomical to group an electric heat-treating furnace and a number of screw machines on the same feeder under a single short-circuit protection device, since a fault on the feeder would shut down the furnace and ruin material worth more than the cost of the added protection required to sectionalize the feeder and keep the furnace operating.

Several alternate locations for short-circuited protection to individual machines and groups of machines depending on their importance in the production set-up are illustrated in Fig. 3. Note that the same amount of short-circuit protection is required at all points between the factory power transformer and the driven machine since the same transformer kva. will pump into fault at all points.

Instantaneous short-circuit protection and time-delay overload protection are universally provided at the point where the feeder taps the factory substation bus. Protection at intermediate points up to the driven machine is therefore necessary only where such protection by preventing loss of the *entire* feeder load would guard essential processes.

In Fig. 3, case A, short-circuit protection is provided at the individual machine. This costly arrangement is resorted to where loss of more than the affected machine might result in shut-down of one or more plant departments. Under such circumstances there are seldom more than two or three machines to a feeder anyway. Overload protection is also used.

Case B illustrates the grouping of several machines under one short-circuit protection device and is used in conditions in which requirements are only slightly less severe than case A. Here loss of the group can be tolerated, but loss of more than the affected group would be extremely costly. Individual machines have overload protection.

By locating short-circuit and overload protection, as in case C, on each side of the point of supply to a feeder or sub-feeder, it is possible to limit loss of load in event of a short circuit or ground to half the load of the entire feeder section.

Use of short-circuit and overload protection to cut off an entire sub-feeder in event of fault anywhere along its length is shown in case D.

In case E full reliance is placed on the feeder breaker at the factory substation to protect the entire feeder and all associated equipment. It is the least costly method of protection, but one that can be used only where no serious slow-down of production will result from loss of feeder load.

Under all conditions short-circuit as well as time-delay overload protection is provided at the feeder breaker in the factory substation. Time-delay overload protection in the form of fuses or breakers is also provided at intermediate points up to the individual machines. This overload protection is coordinated as to time sequence so that the machine or group of machines causing the overload are removed before the supply breaker operates to remove the entire feeder load from the lines.

Estimating Charts for 60-Cycle Line Design

Voltage regulation, line loss, maximum loading and choice of voltage and conductors for distribution and transmission from comprehensive family of charts

G. D. McCANN, Westinghouse Electric & Manufacturing Company*

ACCOMPANYING CHARTS were developed to cover the practical range of voltages and conductors encountered in both transmission and distribution circuits and to provide a ready solution to all of the common types of problems. These include the voltage regulation or line loss of a given line for a given load, the determination of the maximum load which can be delivered over a line for a given regulation or loss, and the proper choice of voltage and conductor in the design of a new line for the transmission of a given load.

Regulation Determines Load

For lines whose voltage is not controlled by capacitors or other regulating equipment voltage regulation is the primary factor in determining the load which can be transmitted. Figs. 1 and 2, based upon this principle, give the power which can be transmitted as a function of regulation. In the design of such a line several combinations of voltage and conductor size will be found to transmit the desired load without exceeding the regulation limit. The final choice will be based upon economics for which the line loss needs to be known, and in these two charts the corresponding loss for each case is also given. The performance of regulated lines is, however, based primarily on the line loss. The charts of Fig. 4 were developed for this case. These charts have been based

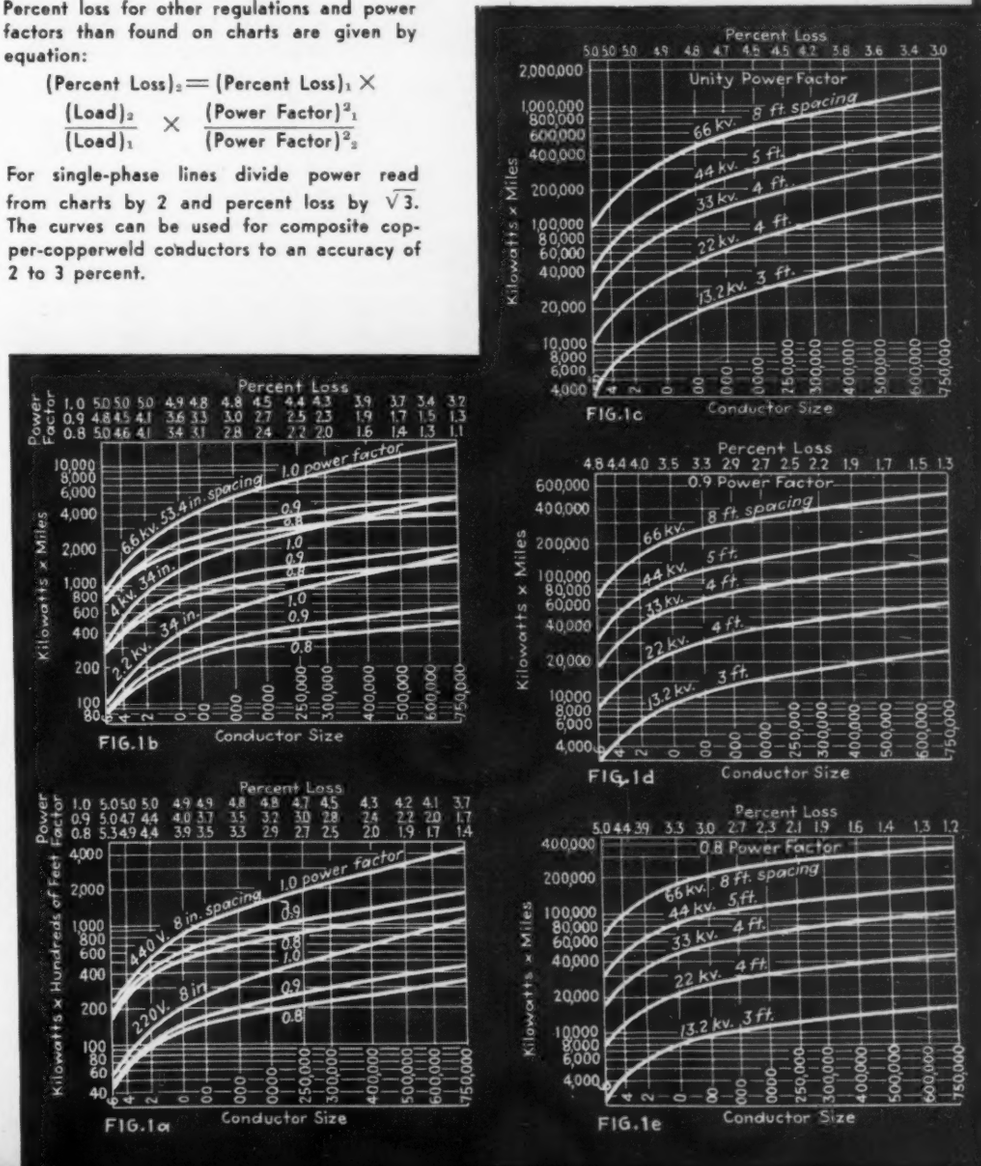
* Industry engineering, East Pittsburgh, Pa.

FIG. 1—Quick-estimating charts based upon 5 percent regulation—stranded copper conductors The curves give load in kilowatts × miles or kilowatts × hundreds of feet which can be transmitted at 5 percent regulation together with corresponding line loss. For a given length of line, power is equal to value read from curves divided by length of line. Power for other regulations is approximately equal to values read from curves multiplied by $\frac{\%\ \text{Reg.}}{5}$. For power factors other than given in charts, multiply values read from curves for unity power factor by fractions given in Fig. 3.

Percent loss for other regulations and power factors than found on charts are given by equation:

$$(\text{Percent Loss})_2 = (\text{Percent Loss})_1 \times \frac{(\text{Load})_2}{(\text{Load})_1} \times \frac{(\text{Power Factor})^2_1}{(\text{Power Factor})^2_2}$$

For single-phase lines divide power read from charts by 2 and percent loss by $\sqrt{3}$. The curves can be used for composite copper-copperweld conductors to an accuracy of 2 to 3 percent.



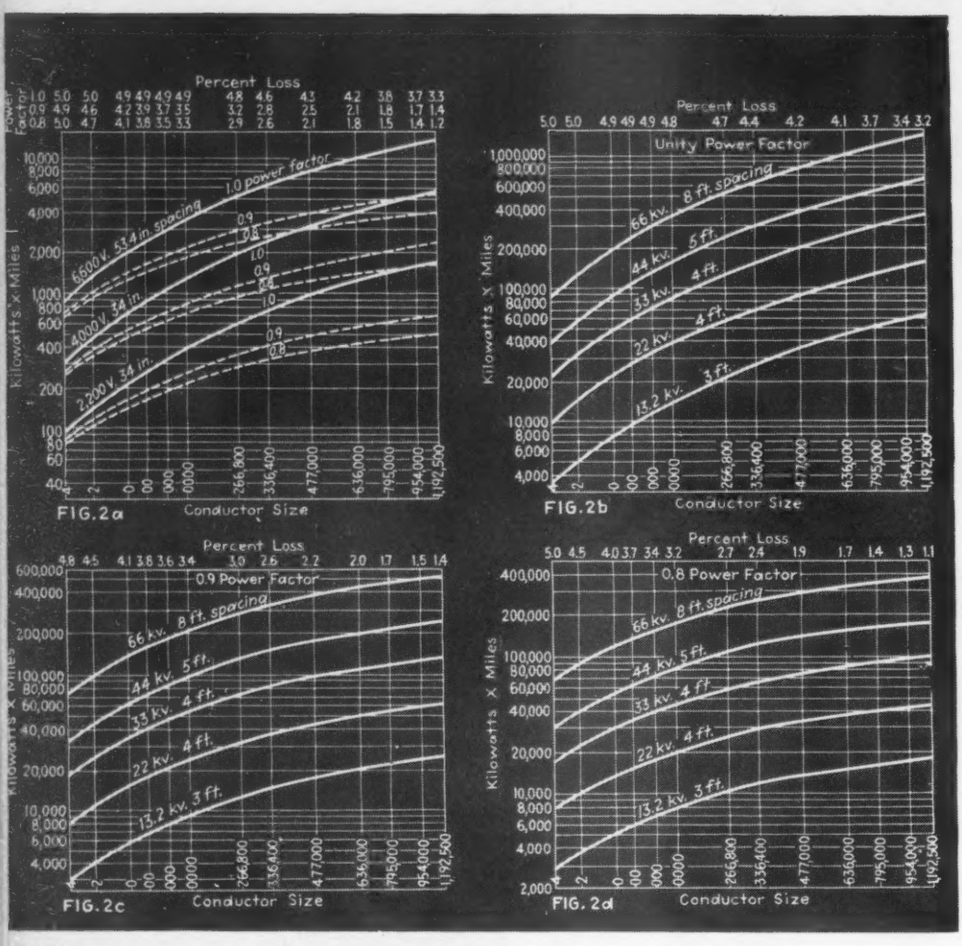


FIG. 2—Quick-estimating charts based upon 5 percent regulation—A.C.S.R. conductors. The application is the same as in Fig. 1

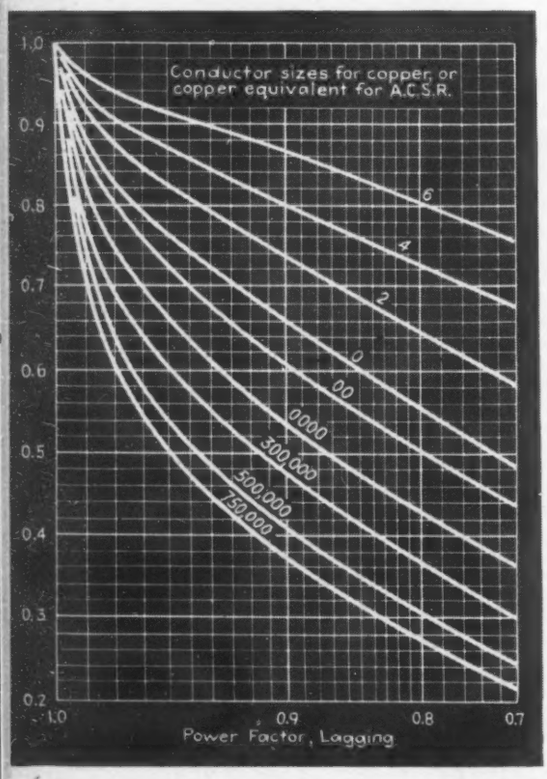


FIG. 3—Effect of power factor on load which can be carried at a fixed regulation

Curves apply specifically for stranded copper conductors at 3 ft. equivalent spacing and 5 percent regulation, but can be used with accuracy of about 10 percent for normal spacing and regulation range and for the same copper equivalent in other common conductors.

upon the common fixed value of 5 percent for regulation or loss, but simple interpolation methods are provided for other values. In addition, although they apply directly to three-phase circuits, they can also be used to good accuracy for single-phase circuits.

Charts Based Upon Regulation

For each voltage a common mean conductor spacing is assumed and the curves are drawn so that it is possible to interpolate to a good degree of accuracy for other voltages than those given. Since the percent loss does not vary more than about a tenth of a percent for each conductor size in each set of curves, mean values are given as shown. The power is proportional to the square of the voltage.

Curves are presented for three common power factors: unity, 0.9 lag, and 0.8 lag. It is difficult to interpolate for other power factors, however, especially between unity and 0.9. To facilitate this the curves of Fig. 3 are provided, showing the effect of power factor on the load that can be transmitted at a fixed regulation in terms of that at unity power factor.

The quick-estimating curves can also be used for other values of regulation if the approximation is made that the load which can be transmitted varies directly with the regulation.

After having determined the load for other power factors or regulations than those for which the curves are drawn, the percent loss can be determined from the relation

$$(\text{Percent Loss})_2 = (\text{Percent Loss})_1 \times \frac{(\text{Load})_2}{(\text{Load})_1} \times \frac{(\text{Power Factor})^2_1}{(\text{Power Factor})^2_2} \qquad (1)$$

Charts Based Upon Loss

In Fig. 4(a) are plotted curves for short lines which show the power in kilowatt times miles which can be transmitted under two conditions.

Fig. 4(b) is for higher voltage lines long enough that distributed capacitance of the line need be considered. Only the condition of equal sending and receiving end voltages is considered here, since regulation does not greatly affect the power for the conductors and spacings practical to use. For all of these curves an arbitrary coordinate system has been used for the abscissa beneath which is plotted the correct spacings for the various conductors.

The curves which give the maximum power which can be transmitted at 5 percent loss can be used accurately for other values of percent loss by multiplying the quantities read from the curves by the factor $\frac{\%\ \text{Loss}}{5}$.

This factor can also be used with the curves for equal terminal voltage to an accuracy of a few percent in the practical range of loss. The exact factor for these curves is $\frac{21\ (\%\ \text{Loss})}{(100 + \%\ \text{Loss})}$. Based upon the

first factor, power is directly proportional to loss. For both sets of curves it is proportional to the square of the receiving end voltage.

The power which can be transmitted over a single-phase line is one-half that of a three-phase line of the same equivalent spacing and line-to-line voltage. Thus, Fig. 4(a) can be used to great accuracy for single-phase lines by dividing the values read from the curves by 2.

Examples of Use

Example 1 (a)—Determine the maximum load at unity power factor and 5 percent regulation which can be transmitted over a three-phase, 5-mile line having 300,000-cir.mil stranded copper conductors and operating at a load line voltage of 22 kv.

From the unity power factor curves of Fig. 2 for this conductor size and voltage, 100,000 kw. times miles is obtained. The load is then $\frac{100,000}{5} = 20,000$ kw. The percent loss read from the curves is 4.2.

Example 1(b)—What is the load for this line at this regulation but 0.95 p.f. lag? Referring to Fig. 3, it is seen that for this conductor size 0.58 as much load can be transmitted at 0.95 power factor as at unity.

Thus, the load is $20,000 \times 0.58 = 11,600$ kw. The percent loss as determined from Eq. 1 is

$$\% \text{ Loss} = (4.2) \times \frac{11,600}{20,000} \times \frac{(1)^2}{(0.95)^2} = 2.64\%$$

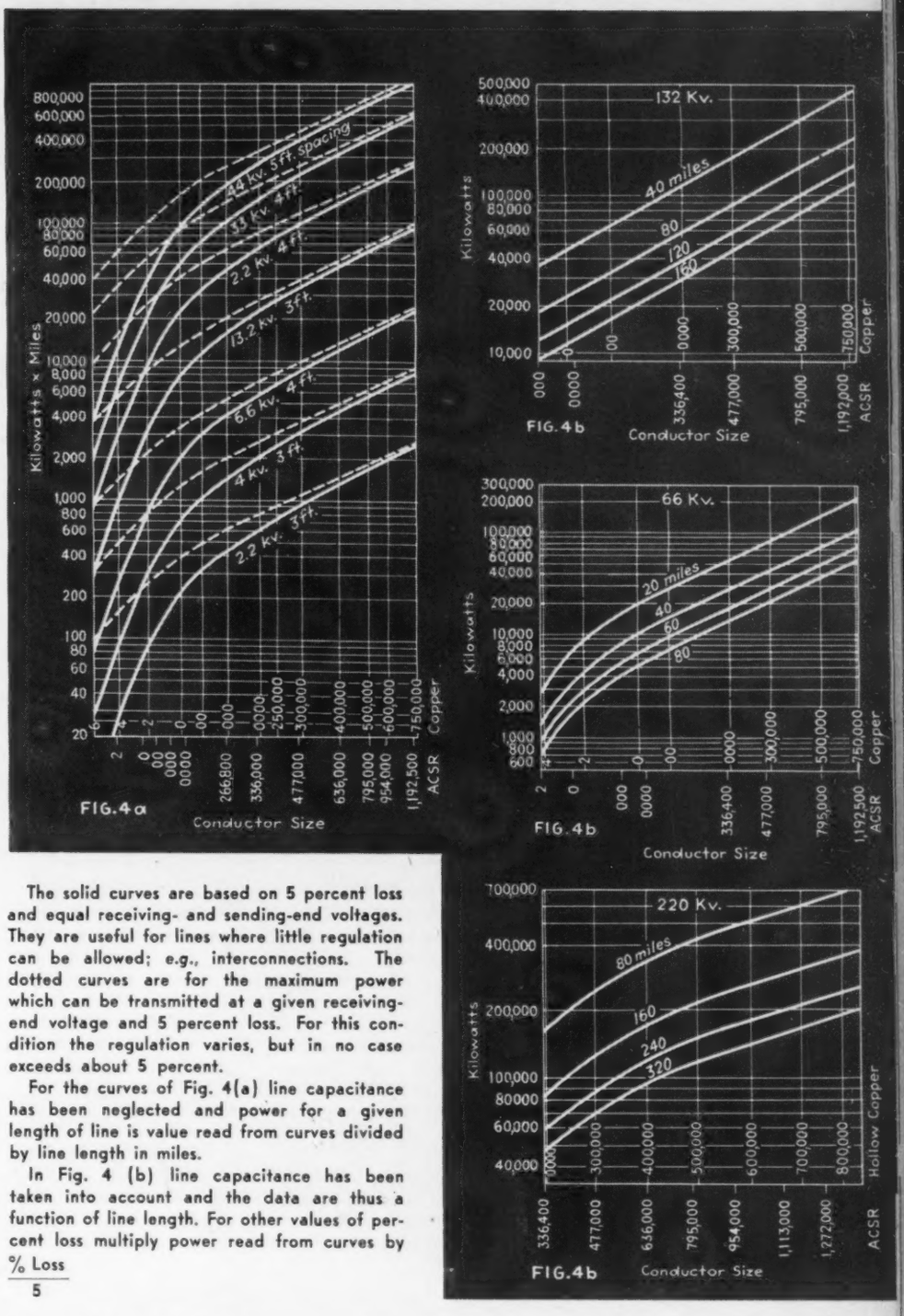
Example 1(c)—What load can be transmitted over this line at unity power factor but 15 percent regulation?

The answer is $(20,000)\frac{15}{5} = 60,000$ kw.

The percent loss is $(4.2)\frac{60,000}{20,000} = 12.6\%$

Example 2—Determine the conductor size and voltage necessary to transmit 10,000 kw. at 0.9 power factor lag for a distance of 10 miles.

This corresponds to 100,000 (kw. times miles). Referring to the 0.9 power factor curves for both copper and ACSR conductors for this load, it is seen that the following lines can be used:



The solid curves are based on 5 percent loss and equal receiving- and sending-end voltages. They are useful for lines where little regulation can be allowed; e.g., interconnections. The dotted curves are for the maximum power which can be transmitted at a given receiving-end voltage and 5 percent loss. For this condition the regulation varies, but in no case exceeds about 5 percent.

For the curves of Fig. 4(a) line capacitance has been neglected and power for a given length of line is value read from curves divided by line length in miles.

In Fig. 4 (b) line capacitance has been taken into account and the data are thus a function of line length. For other values of percent loss multiply power read from curves by $\frac{\% \text{ Loss}}{5}$

For single-phase lines divide power read from charts by 2.

FIG. 4—Quick-estimating charts based upon 5 percent loss

Stranded Copper		% Loss	A.C.S.R.	% Loss
Voltage	Cond. Size	2.2	Cond. Size 636,000	2.0
33,000	300,000 cir. mil	3.5	cir. mil No. 0000	3.4
44,000	No. 0	4.4	No. 2	4.5
66,000	No. 4			

If it were desired to allow a 10 percent regulation instead of 5 percent, the value of kilowatt miles to refer to on the curves would then be 50,000 instead of 100,000.

The use of the quick-estimating charts based upon line loss is quite similar. For instance, if the line of example 1 were equipped with capacitors, so that regulation would not be excessive, examination of Fig. 4 shows that it could deliver a maximum of $\frac{116,000}{5} = 233,200$ kw. at 5 percent loss.

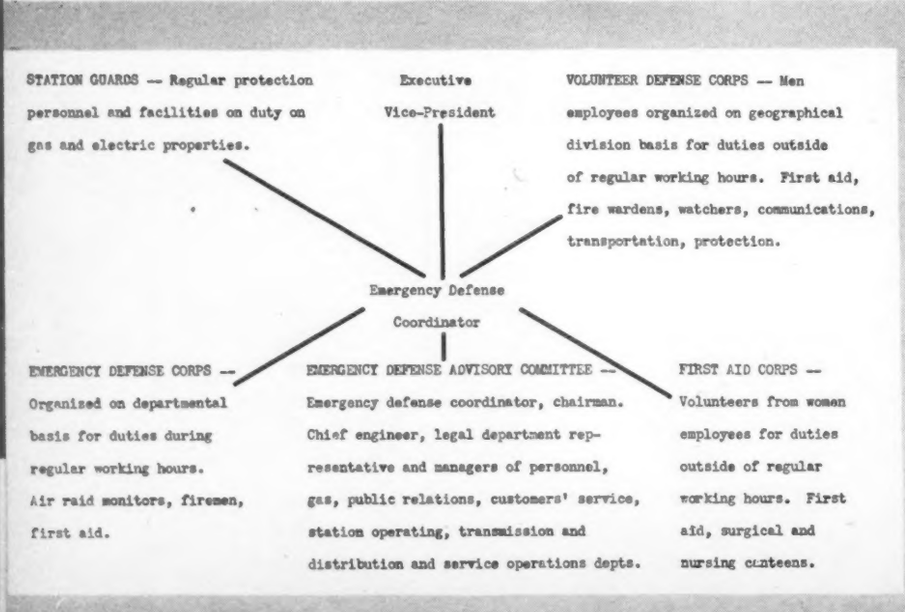
Utility Responsibilities in Civilian Defense

Philadelphia Electric Company organizes its employees for protection of personnel and service and arranges street lighting for blackout

RESPONSIBILITY of the electric utility in civilian defense has two aspects. One is internal organization for maintenance of service and for protection of plant and personnel during emergencies of bombing attack and to guard against sabotage. The other is close coordination with, and subjection to, civilian defense agencies outside the utility so that street and other exterior lighting may be rapidly extinguished when blackout becomes necessary and so that system damage suffered in attack and constituting a public hazard may be quickly guarded and repaired. The emergency defense plans of the Philadelphia Electric Company and the arrangements made by the company for the test blackout staged February 3 in that city and surrounding territory offer good examples of the two functions.

The company's internal civilian defense organization is shown in the accompanying chart. Selected to head up the organization, with the title of Emergency Defense Coordinator, and reporting directly to the executive vice-president of the company, is a man of long experience in military command and who as director of industrial sales is familiar with both the company system and the industrial customers it serves. As counsel to him is the Emergency Defense Advisory Committee, of which he is chairman and which includes the chief engineer, a representative from the legal department and the managers of the personnel, gas, public relations, customers' service, station operating, the transmission and distribution and service operations departments. Reporting to the Emergency Defense Coordinator are four groups. One consists of the regular protection facilities of plants and other property under the direct authorities of the manager of the gas department and the assistant general superintendent of the station operating department. The second group is the emergency defense corps under the command of the property protection engineer. In this group are employees designated as air raid monitors, firemen and administers of first aid. The organization of this group follows the departmental lines of the company and each member will take up emergency duties, in which instruction and training have been given, right at or very near to the place where he works. These two groups are on duty or on emergency call in their regular employment hours.

ORGANIZATION of intra-company civilian defense


STATION GUARDS — Regular protection personnel and facilities on duty on gas and electric properties.
Executive Vice-President
VOLUNTEER DEFENSE CORPS — Men employees organized on geographical division basis for duties outside of regular working hours. First aid, fire wardens, watchers, communications, transportation, protection.
Emergency Defense Coordinator
EMERGENCY DEFENSE CORPS — Organized on departmental basis for duties during regular working hours. Air raid monitors, firemen, first aid.
EMERGENCY DEFENSE ADVISORY COMMITTEE — Emergency defense coordinator, chairman. Chief engineer, legal department representative and managers of personnel, gas, public relations, customers' service, station operating, transmission and distribution and service operations depts.
FIRST AID CORPS — Volunteers from women employees for duties outside of regular working hours. First aid, surgical and nursing canteens.

Volunteer Groups

The other two groups, one of men and one of women, are comprised of employees who have no protection or emergency duties during working hours and who have volunteered to respond to call outside of business hours. The men's group is designated the Volunteer Defense Corps and is headed by a representative of the transmission and distribution department. The most important assignment of this group is to "back up" the operations departments of the company. In an emergency each member reports to his designated position close to his home ready for duty after a minimum of travel. The head of the women's committee of the employees' association of the company is in charge of the women's volunteer group, designated as the First Aid Corps. The functions of this group are also shown on the chart.

In the development of this defense organization within the company the very worst possible conditions that might occur were envisaged as the determinants of the set-up. Communications might wholly fail; transportation might be impossible; police and

fire department protection might be unobtainable. The aim of the organization is that the people in the company will be entirely competent and ready to protect and to care for themselves and to assure that the company's service will be maintained without any help from "outside" if such help is not available.

Street-Lighting Control

While this elaborate emergency defense corps within the Philadelphia Electric Company is necessary for the best protection of electric service and company property, it must not work at cross-purposes with the defense council for the Philadelphia area. In other words, the company organization is a specialized part of the entire community organization and must dovetail absolutely with the co-ordinated effort of the area. It should be realized that the community electric services are the responsibility of the municipalities as well as of the company. Street lighting, for instance, is a community and a municipal problem. Therefore, in Philadelphia a clear and distinct division of responsibility was worked out with the local defense co-ordinator.

In Philadelphia most of the street lighting is on series circuits and is owned by the company. Many of these circuits are fed from constant-current transformers on poles with clock switches for turning the lights on and off. To give control of these circuits into the hands of civilian defense authorities was an obvious necessity, and as obviously it was the responsibility of the utility to equip the circuits with switches so that air raid wardens could turn them off and on. How this was done in Philadelphia is a good example of the type of cooperation which may be attained between utility and civilian defense authority.

The times switches are of the usual type, making "on" and "off" contacts to set in operation a circuit breaker on the primary side of the constant-current transformer. To add manual control was simply a matter of paralleling the clock contacts with a single-pole, double-throw switch in a suitable housing. Each air raid warden who had a street light control assignment was furnished with a stick like a drum major's baton to enable him to strike the end of an operating push rod projecting from the side of the switch box.

MAP of street-lighting areas and locations of control points, typical of those supplied to civili defense authorities

Two days before the blackout the switches were all installed, 260 of them in Philadelphia alone at a cost of less than $25 each, and the sticks distributed to the designated wardens by civilian defense officials. Maps of circuit areas and locations of switch poles were made and turned over to the civilian defense authorities. Wardens were instructed in the operation of the switches and the city assumed full responsibility for street lighting blackout.

The scheme worked admirably. All but a few of the circuits went dark immediately when the blackout signal was sounded. The exceptions were caused by impatient wardens who did not allow time for the breaker to operate and kept striking the switch on and off. In each such instance it was demonstrated that same night that the operator, not the switch, was at fault. Thus the switching arrangement for street lighting proved wholly adequate mechanically and electrically and, as it should, rests complete and undivided control for blackout in the hands of civil authority.

Multi-Purpose Regulator Aids Voltage, Load Control

Regulator in program to deliver adequate 22 kv. voltage under heavier loadings permitted by developments focussed on reliability and without adding transmission facilities

W. J. LYMAN, Duquesne Light Company*

STUDIES of voltage regulating requirements at one of the principal transmission substations of the Duquesne Light Company led to the adoption of a unique design of regulator which not only does the job of regulating voltage in critical areas but also controls loads on individual 22-kv. circuits and on the main transformer banks. By balancing loads during normal and emergency conditions the effective capacity of the transmission system is increased, thereby considerably reducing the over-all investment per kva. of available capacity.

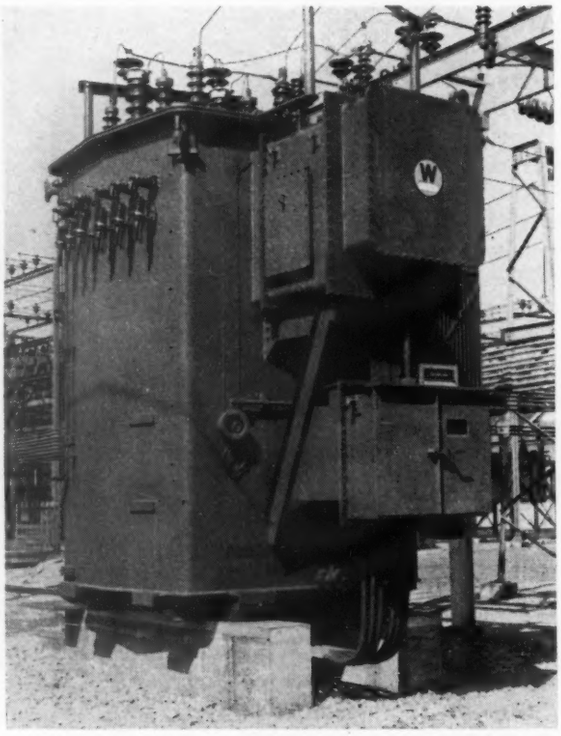
The regulator is able to shift power easily and smoothly and in amounts approximately equal to the values that had been determined by calculation. In no case was the range of the regulator inadequate.

Regulator Details

It has been possible to increase the firm power rating of the substation by 4,000 kva. and simultaneously have better operating conditions. At the average unit cost for 66/22-kv. substation capacity, this 4,000 kva. in itself is worth more than the cost of the regulator installation. Useful capacity of the 22-kv. lines has been increased by an even greater amount.

The regulator is operated normally in the circuit where it is most useful and in case of emergency is switched to another circuit if necessary. Several abnormal conditions have already arisen when the regulator was used to prevent overloading of circuits or to eliminate low-voltage conditions.

Instead of providing bus regulators in series with the main 66/22-kv. banks, a 22-kv., 12,000-kva. regulator was installed at the Ambridge substation so arranged as to feed the auxiliary bus from one of the main banks. The regulator can be switched into any one of the 22 kv. circuits. In selecting the regulator flexibility as well as economy were paramount considerations. Calculations showed that a maximum boost of 10 percent and a maximum buck of 10 percent would be adequate, although it was not important that this entire 20 percent range be covered on one continuous tap changer.



THE 22-kv., 12,000-kva. (circuit rating), 10 percent combination voltage regulator and phase shifter at Ambridge substation; associated bus work was reduced to a minimum

Substantial saving was made by providing in the regulator a 5 percent fixed boost and a ± 5 percent variable range, giving a total of from zero to ± 10 percent. A "no-load" tap changer was provided so that the fixed boost can be reversed or cut out with a very short interruption. Thus three ranges are available, *i.e.:*

0	to	+ 10%
− 5%	to	+ 5%
− 10%	to	0

In order to use the regulator to control either load or voltage, two other "no-load" tap-changers were provided so that the angle between the variable voltage and the bus voltage can be made zero, 30 deg., 60 deg., or 90 deg.

When it is desired to put the regulator in service in any line the "no-load" tap changers are first set to give the desired range based on previous test, experience, or calculation, and depending on whether it is desired to boost voltage at some point, balance line loading, or shift power between stations.

The regulator is rated 12,000 kva., OISC, and arranged for future installation of fans to handle 15,000 kva. Windings are protected against surge voltages by three lightning arresters and six Deion gaps.

*Electrical planning engineer.

With the regulator in series with the Ambridge-Coraopolis circuit and connected to boost with an in-phase voltage, it was found that the voltage at Coraopolis substation could be boosted about three volts. Effect on the voltage at Sewickley substation was not noticeable.

Voltage Regulator

With the regulator in the same line but connected to boost at 30 deg., and with the Sewickley circuit opened at Ambridge, the Coraopolis voltage was raised four volts by using fourteen of the sixteen steps available in the regulator. The Sewickley voltage was increased by four volts.

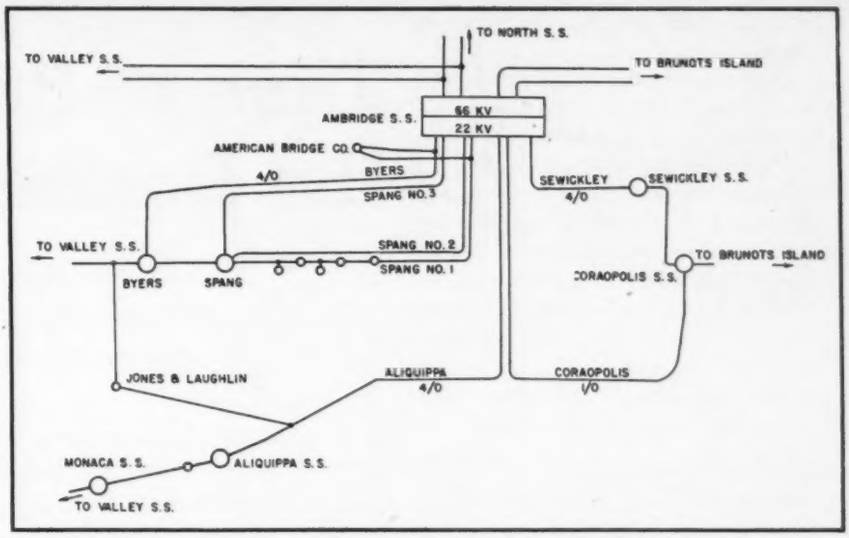
One possible use for this regulator is to maintain adequate voltage on the Aliquippa-Monaca line when the Valley-Monaca circuit is out of service. The regulator was put in series with the Aliquippa circuit and the line opened at Valley substation. The Monaca voltage dropped four volts. The regulator was then able to bring the Monaca voltage back up to within one volt of normal by using thirteen of the sixteen available steps.

Balancing Circuit Loads

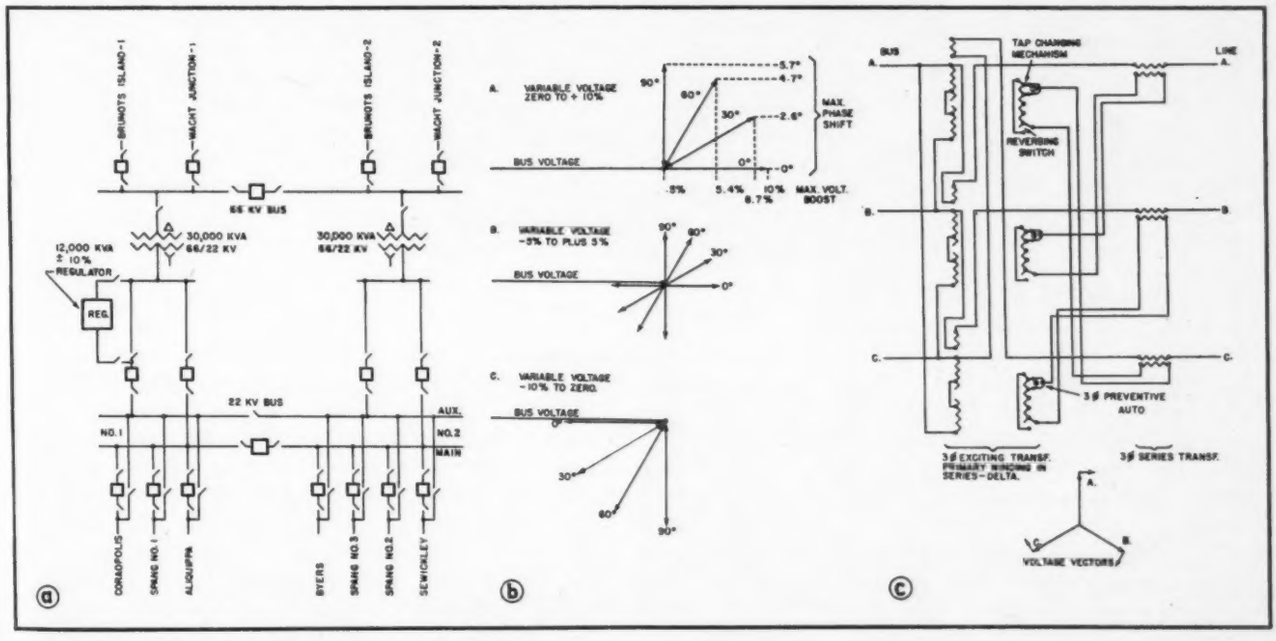
Ambridge-Coraopolis circuit normally carries a very small load. By placing the regulator in the circuit and connected on the 30 deg. tap it was possible to increase the load on the Coraopolis line from 50 amp. to 150 amp. by using twelve steps. Power factor of this line load remained practically constant. Load on the Sewickley circuit in the meantime decreased from 160 amp. to 105 amp.

The Aliquippa line also does not normally take its share of the district load. The regulator connected in this circuit on the 60 deg. tap was able to increase the load from 100 to 260 amp. by using eleven steps. The power increased from 3.8 mw to 10.2 mw, with practically no change in power factor.

A vulnerable point in the transmission to this district is the possible loss of the double-circuit line, consisting of the Spang No. 3 and Byers circuits. On opening both of these lines with the regulator in the Aliquippa circuit the regulator succeeded in reducing the load on the Spang No. 1 line from 350 amp. to 270 amp. by using twelve steps on the regulator. When connected in the Byers circuit it was possible to increase the Byers line load



AMBRIDGE REGULATOR was connected in turn to five of the above lines through the auxiliary bus and operated at various phase angles, both boosting and bucking



REGULATOR establishes voltage level and phase shift

(a) Regulator connected to Ambridge auxiliary bus has capacity equal to largest outgoing 22-kv. circuit and can be switched to any one of seven

(b) Twelve combinations of voltage level and phase-angle shift available to regulate voltage and load division

(c) Regulator has three-phase exciting winding (with 5 percent boost) three-phase series transformer and "preventive auto." Tap changing under load has sixteen steps of ⅝ percent. As shown, the connections are for 0 to —10 percent voltage at quadrature for circuit load reduction or shift elsewhere

from 3.4 mw to 12.4 mw by using eleven steps.

Ambridge-Spang No. 1 circuit, due to its impedance and the loads connected to it, always takes more than its share of the district load. The regulator was connected in the Spang No. 1 circuit on the 90 deg. connection to perform as a phase shifter. By bucking through the regulator the load on the Spang No. 1 line could be reduced to practically zero by using only five steps. Bucking only two steps equalized the loads on the Spang No. 1 and Spang No. 2 circuits.

Load Balancing

A test was performed where load was shifted to Brunot Island, the next 22-kv. supply point to the east, by putting the regulator in the Sewickley line connected for 90 deg. and 10 percent buck and opening the Coraopolis circuit. Running the regulator to the full buck (sixteen steps) relieved the Ambridge bank of about 4,800 kva. This load was backed up on the 22-kv. circuits from Brunot Island. The amount of relief had been determined by calculation as being approximately 4,000 kva. and the tests indicated a somewhat higher figure. The voltage at Sewickley and Coraopolis remained constant. Although the regulator retards the angular position of the voltage and thus reduces the kilowatt output, it maintains the voltage magnitude at normal so that the circuit still supplies reactive kva. and prevents an appreciable drop in voltage.

Another test was performed where load was shifted from Ambridge to Valley substation by connecting the regulator in the Aliquippa circuit and opening the Rochester line breaker at A. M. Byers. This latter move can be performed from Ambridge substation by remote control. By turning the regulator to full buck the load on the banks at Ambridge was reduced about 5,600 kva. Calculations showed that the regulator should transfer about 5,100 kva. under these conditions.

With one of the main banks out of service the total station load is further reduced about 2,500 kva. This test, therefore, showed that with a bank outage at Ambridge the load on the remaining bank could be reduced nearly 8,000 kva. below the normal load on both banks. Voltage at Aliquippa substation did not drop.

Time to Survey the Domestic Market

Increased incomes to wage earners open a different residential market — Repair programs needed and campaigns to resell the "use" of appliances*

R. H. JONES,† Electrical League of Cleveland

SOME interesting developments now are taking place on the question of appliance repair. In order to determine for ourselves the condition of appliances owned by Cleveland families, a survey was recently completed involving 1,000 homes. In these 1,000 homes 59 appliances were out of use because they were in need of repair. On the surface this appeared to be serious, apparently involving the loss of considerable revenue to the utility.

On making a careful recheck of all homes originally surveyed to determine *how long* the appliance had been out of service and *how soon* it would be repaired, a totally different set of facts was disclosed. Instead of representing a loss of approximately 16 cents per customer per year, the new figure was barely over 3 cents per customer per year. It should not therefore be assumed, simply because an appliance is not in service at the time of the call, that it has been out of repair for a protracted period or that it will not soon be back to duty.

Appliances Unused

Another appliance survey, as yet incomplete, but which also will involve 1,000 homes, discloses that in 275 contacts that have been made to date some highly significant information of entirely a different sort is uncovered. In these 275 homes there are 157 appliances in good repair which are seldom used. If this ratio continues in the remaining 725 homes to be surveyed it will mean that 571 appliances in those 1,000 homes are on pantry shelves collecting dust.

A rollcall of these appliances indicates that they are by no means specialties, such as hair dryers, curling irons, cigarette lighters, etc. On the contrary, they include such important items as broiler grills, of which five are rarely used; eight clocks, if you can imagine that; nineteen coffee makers; four room heaters; five hot plates; three roasters; 22 sandwich toasters; 24 waffle bakers and eleven toasters.

This is a serious situation, one which demands some serious thinking. Somewhere between the point of acquiring the appliance and shelving it, the job of selling "use" has been neglected. It would, therefore, seem to be logical to inaugurate a plan to sell the economical advantages of continued use or new uses of appliances now owned. We are all conscious of the appeal which is being made to the nation to aid in national defense. We are constantly being informed of the need for conservation of time, energy and our natural resources.

It would seem logical, then, that the electrical industry should use every reasonable effort to inform the nation of the conservation of natural and human resources by the wise use of electricity for light, for heat and for power. Conservation of eyesight in the office, the factory and the home is made possible by good light. Conservation of health in the building of strong bodies is a keystone in the story of cooking electrically. High-speed production, conservation of human energy is made possible by the use of electrically operated machines, in the home, in the office and in the factory. These are stories we may tell with pride. In all seriousness, bread and butter thinking along these lines is indicated for 1942.

*Condensation of address before sixth annual Conference of I.A.E.L. †Secretary.

Utility Installs Model Health Facilities

Employee health center recently modernized by the Commonwealth Edison Company, treating 30,000 annually, rivals hospital in completeness of facilities

RIVALING modern hospitals in completeness of facilities, Commonwealth Edison Company's modernized medical offices in Chicago are a stand-out example of modern trends in industrial medicine and a testimonial to the care with which public utilities guard the health of their employees.

The culmination of an employee health program initiated by the company 43 years ago, in 1898 under Dr. J. D. McGowan, the new facilities increase the scope and effectiveness of medical service to employees in the diagnostic as well as preventive sense. In addition to private examination rooms and clerical office, the health center offers the most modern X-ray equipment, a fully equipped medical laboratory, surgery, electrocardiograph apparatus and a special eye, ear, nose and throat examination room.

Not intended to supplant medical services of private practice, treatment of the medical division is given only in accident and emergency cases and for minor ailments which do not require outside medical attention. Procedure in securing medical attention is simple. Visits to the medical division may be made at the employee's own request to a supervisor or at the recommendation of a supervisor, when illness is suspected or apparent.

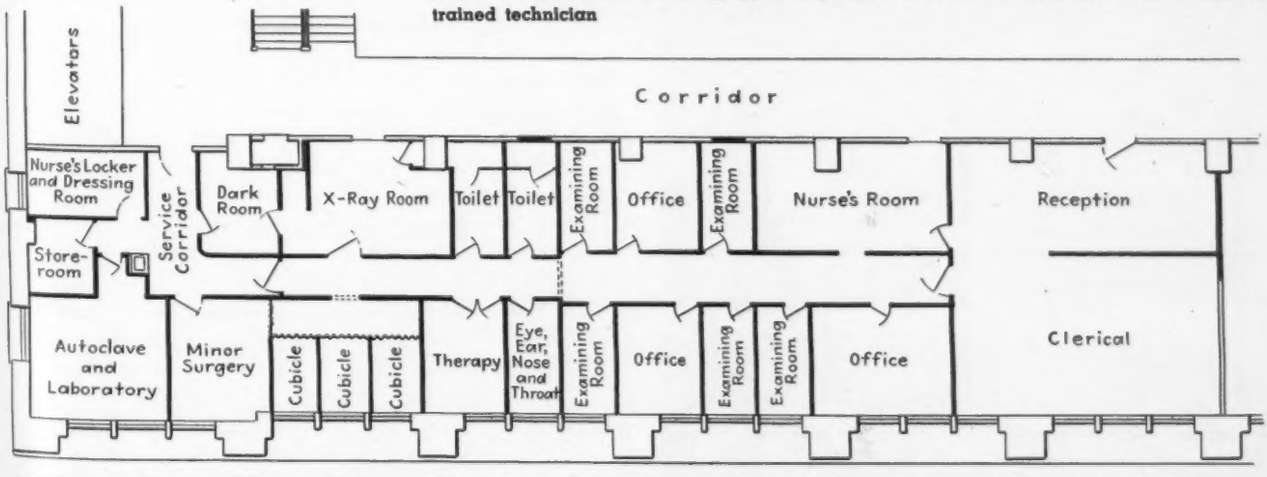
During 1940, out of a total of 10,000 employees, visits to the medical division were 32,240. Of these 4,513 were accident cases, 2,943 represented examinations and 24,784 were classified as health cases. In addition 8,000 calls were made during the year by company-visiting nurses.

Staff of the present modernized medical division of the company, under Dr. Thomas C. Douglass, comprises seven doctors (including one at each of two service buildings), five nurses, a laboratory technician and four clerical employees. This trained staff is available to employees for consultation and advice and makes periodic examinations of the personnel so as to discover physical defects before they become serious.

In equipping the office emphasis was placed on elimination of dust-catching moldings, window linings and casings. Asphalt tile floors, acoustic ceilings and high-intensity indirect lighting are features of admittance and consultation and treatment rooms which are arranged in sequence to expedite service and reduce lost motion.

Indirect lighting is used throughout except for a large-area high-intensity fluorescent lighting unit in the surgery room. All steel office furniture is of advanced design and most of the special furniture and equipment is of stainless steel.

MEDICAL LABORATORY is equipped to perform all standard tests and is in charge of trained technician



LAYOUT of consultation rooms, laboratory and surgery are coordinated to expedite service to patients and reduce lost motion

Analyzer Guides Adjustment

E. L. SCHLOTTERE, Assistant Superintendent of Substations, Philadelphia Electric Company

R. M. SEITZ and S. GOLDSMITH, Operating Engineers, Cincinnati Gas & Electric Company

MANY so-called circuit breaker "failures" that call down the wrath of utility operating men on the head of manufacturers can more correctly be attributed to improper field adjustment and maintenance of breakers than to faulty design and construction. Modern breakers as a class are rugged in construction and well able to withstand the duty imposed on them. Much of the trouble is with maintenance methods. The narrow limits of time and travel imposed on oil and air breakers in all voltage classifications by current demands for high-speed reclosure require precision adjustment and demand that these adjustments be carefully maintained if the degree of precision operation designed into the breakers is to be realized. This demands that field maintenance technique and equipment keep step with breaker technology.

The present tendency in circuit interrupters for utility service is toward circuit breakers for medium- and low-voltage indoor applications and toward high-speed (30- and 20-cycle) reclosures for medium- and high-voltage outdoor applications. In addition, high-speed reclosure of medium- and low-voltage circuits, which has been in use for several years, is still in favor.

Mechanisms of such modern circuit breakers include a large number of variable adjustments. The correct relationship among these is essential to proper performance. These relationships are not discernible by human observation. However, modern electrical and mechanical means are available to determine them. Such is the "circuit breaker operation analyzer" described by two of the present writers in a previous article.* It is the purpose of this article to discuss applications of this curve drawing analyzer to field maintenance of a number of typical breakers of the newer air-blast and ultra-high-speed type and show how the use of the analyzer made it possible to attain the degree of precision operation intended by the breaker designer.

Study of the cases cited and analysis of experience with the analyzer in maintenance programs of companies with which the authors are connected leads to several pertinent conclusions.

1. Time-travel analysis of breaker operation has increased the interval between breaker maintenance periods as much as three times.

2. It has emphasized the importance of dependable breaker operation in the close coordination of relays.

3. The graphical time-travel chart has slashed maintenance costs by largely eliminating cut-and-try breaker adjustments.

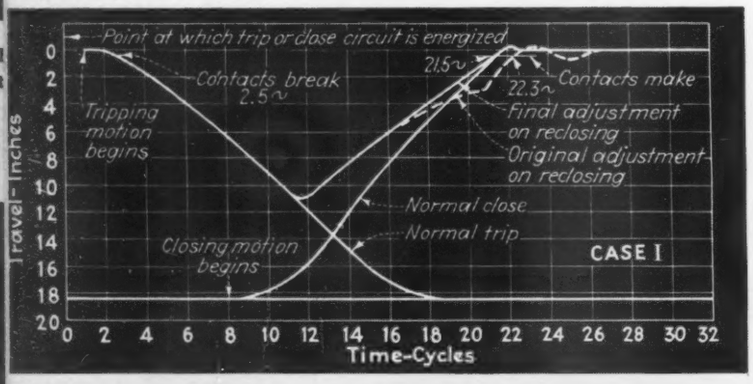
4. In the chart the maintenance foreman has permanent graphic proof that breakers in his charge are maintained properly.

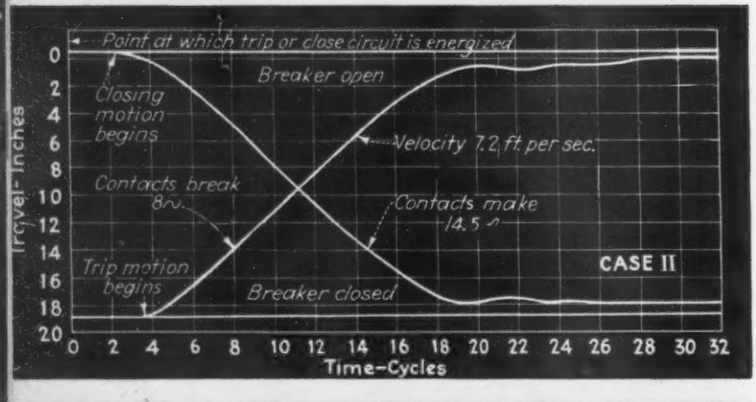
5. Time-travel analysis has emphasized the importance of correct contact velocity in the application of modern arc control devices, previously entirely neglected.

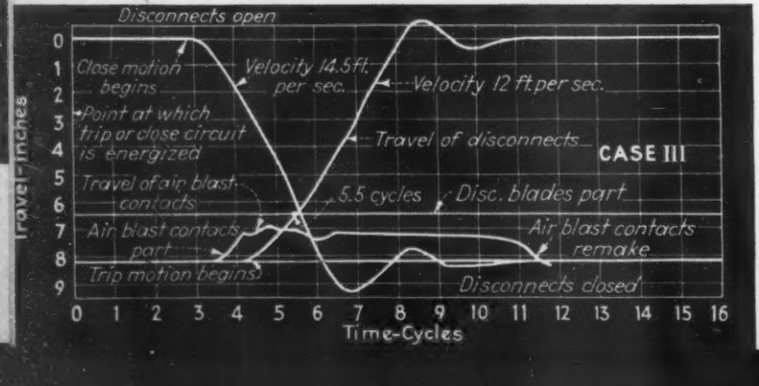
6. Defects in the design of certain types of breakers have been revealed, which were unknown by designers or were not called to purchasers' attention. This has led to correction of serious defects not known to exist and will eventually eliminate designs which cannot be economically maintained in a satisfactory manner.

7. It has given management assurance that breakers are being maintained in the manner intended by the manufacturer.

8. Maintenance crews can be quickly trained in the use of the instrument and analysis of records and equipment has been found to stand severe duty in the field.







Case I—A 69-kv., 1,000,000-kva. oil-circuit breaker of an older type rebuilt for ultra-high-speed 20-cycle reclosure, with a new mechanism and new contacts. This breaker was first adjusted

*"Device Aids Maintenance for Best Breaker Tripping," "Electrical World," July 30, 1938.

# of Ultra-High Speed Breakers

Trend to high breaker speed emphasizes the importance of instrument guides in breaker maintenance

without an analyzer, as shown by the dotted line. On the closing stroke the dotted line shows that the contacts make, part and remake. This condition was corrected by adjusting the mechanism by instrument to give the normal closing operation shown by the solid curve. As adjusted, time for energizing trip coil to parting of contacts 2.5 cycles; to end of travel 18.5 cycles. On closing, time to start of motion 8 cycles, to close contacts 21.5 cycles, to full close 21.75 cycles.

Case II—Typical curve for "H" type breaker of the hydro-blast type, 15-kv., 600 amp. Action of springs and motor mechanism are clearly visible throughout the operation. Motion at contact make and contact break is positive with no slowing up on make until well after the contacts engage. Speed, shown by slope of curves, is well within the proper band and no irregularities are apparent.

Case III—An Allis-Chalmers air-blast circuit-breaker type AB-15-250 rated 15 kv., 600 amp. Action of the main and disconnecting contacts and coordination between them is clearly shown. On opening, the main air blast contacts part first. The curve shows that this occurs at 3.6 cycles. Disconnect contacts part at 5.5 cycles. At 11.4 cycles the main contact remakes as indicated. Thereafter, in closing, the only movement is that of the disconnect. Relationship between the main air-blast contacts and disconnect contacts, fundamental to this type of breaker, cannot be determined by visual means.

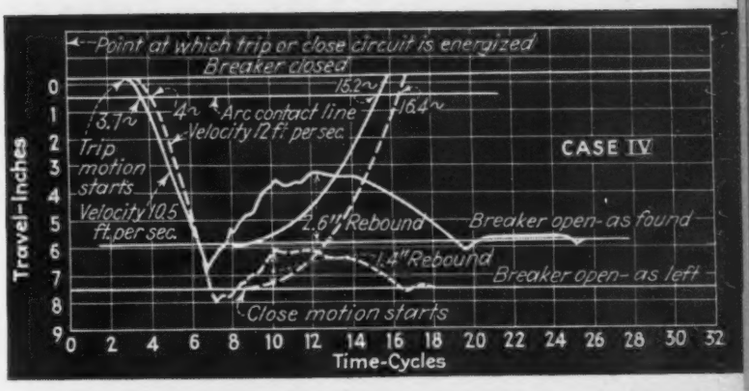
Case IV—A Westinghouse type U Deion truck-type air circuit breaker. As found, the rebound when this breaker was opened was 2.6 in. for a travel of 5.8 in. Maximum allowable rebound recommended by manufacturer was 25 percent of the stroke. After adjusting pull rods so that all three phases struck the bumpers together and tightening the bumpers, rebound was reduced to 1.4 in. on a 7.5-in. stroke. Solid curve shows as found condition, dotted curve as left. As found, time to parting of contacts on opening 3.7 cycles, to end of stroke 6.3 cycles; on closing time to making of contacts 15.2 cycles. As left, time to parting of contacts, on opening 4 cycles, to end of stroke 6.4 cycles; on closing to making of contacts 16.4 cycles.

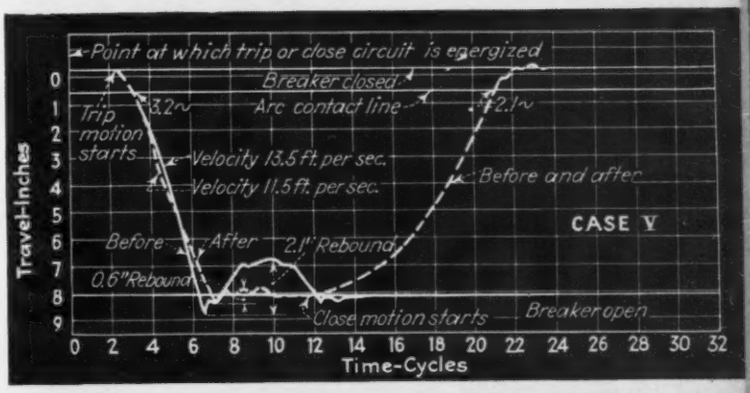
Case V—Type 150 U 12, 15-kv., 600-amp. Deion air circuit breaker, Westinghouse. Prior to installation of shock absorbers and additional bracing, rebound was 2.1 in. on an 8-in. stroke. After installation of shock absorbers, rebound was 0.6 in. Speed of mechanism was 13.5 ft. per second as found, 11.5 ft. per second after adjustment. There was no change in time to open contacts (3.2 cycles) and time to close contacts was 21.2 cycles. This chart is typical of 150 U 12 and 150 U 22 breakers.

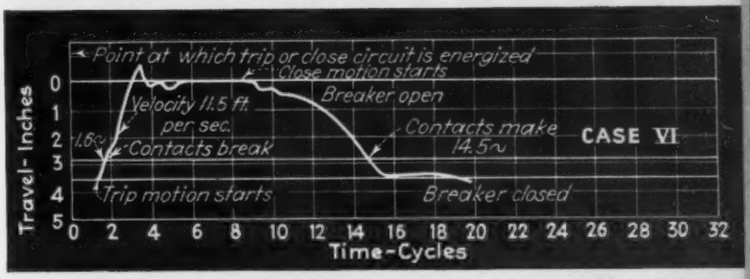
Case VI—An I-T-E 5-kv., 600-amp. type H.V. air circuit breaker. Action of the unusual type of shock absorber, as shown by the curve, is particularly notable. It is to be noted that the contacts break in 1.6 cycles after trip current is applied and that speed of opening is very fast, 11.5 ft. per second, with the whole operating cycle taking place in only 3 cycles (0.05 second). It is evident that such speeds and short time intervals are beyond the ability of men doing breaker maintenance by visual observation to cope with. This breaker uses a brake arrangement to take up shock at the end of the opening stroke. Pressure on the brake shoes increases as the breaker opens.

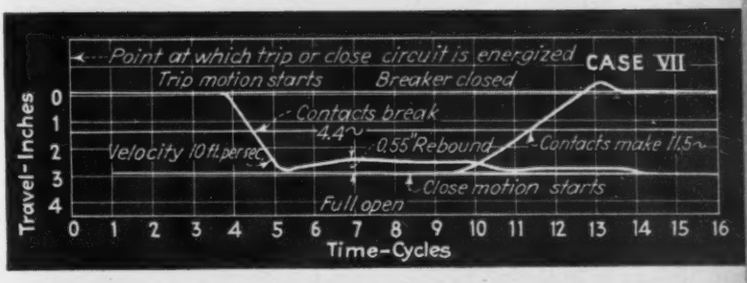
Case VII—A General Electric Magne-Blast oil circuit breaker is the AM 10-10 type rated 5 kv., 600 amp. Chart shows movement of the main contacts only, but the speed and rebound of the arcing contact can be easily obtained from it. Computed speed of arc contact is 18 ft. per second, computed rebound is 0.55 in. Time to opening of contacts is 4.4 cycles. Time to close contacts 11.5 cycles.

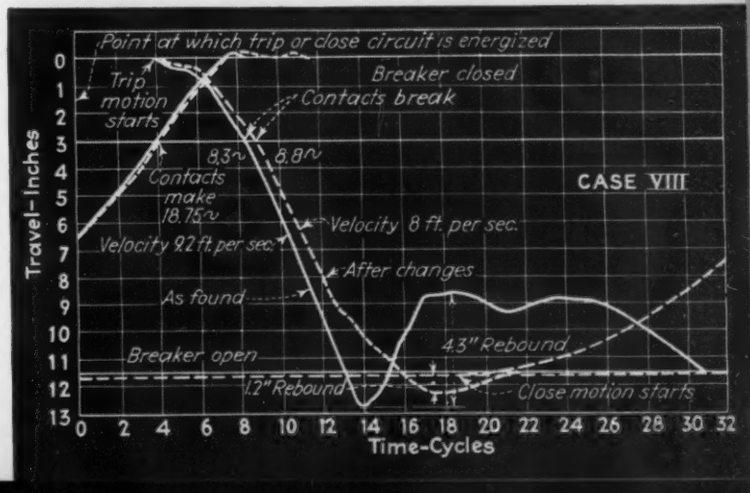
Case VIII—A General Electric type FHK-130-20B 15-kv., 600-amp. oil circuit breaker. Solid curves show breaker operation as found. Speed of mechanism 9.2 ft. per second. Time to open contacts 8.3 cycles, to end of stroke 13 cycles, rebound 4.3 in. Manufacturers' recommended values, time to part contacts 9 cycles, speed 5-8 ft. per second, rebound 1.2 in. After installation of new shock absorbers and readjustment it is seen from dotted curve that all values recommended are met and breaker is in perfect condition.











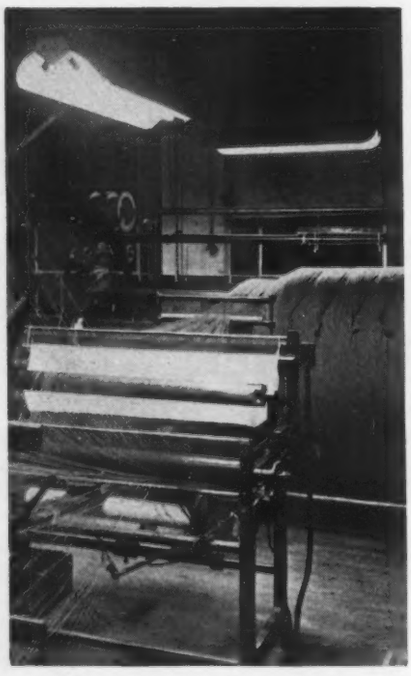
Better Lighting Raises Output of Woolen Cloth

Group of lighting applications, all in one textile mill, illustrate the benefits of intensities between 45 and 350 ft.-candles

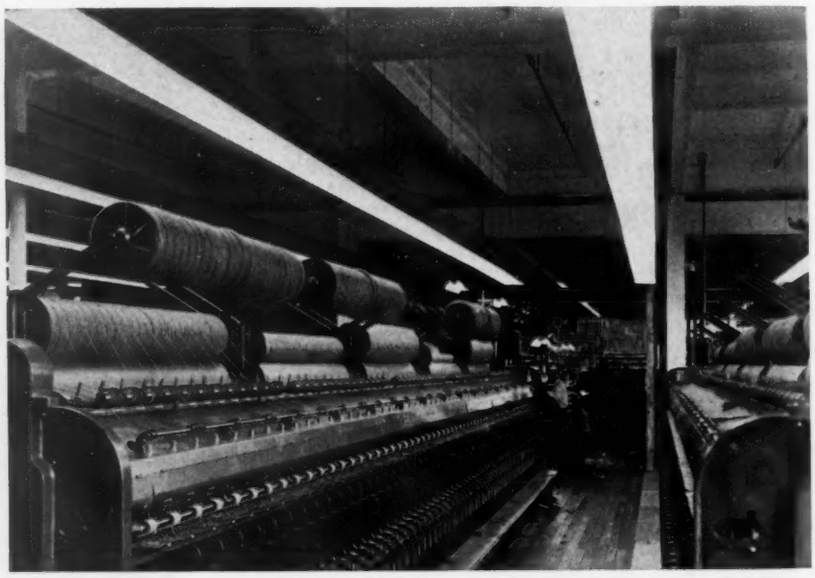
OPERATING CONDITIONS at the Uxbridge (Mass.) Worsted Company's mill are being steadily improved by a systematic program for fluorescent lighting of major processes. Intensities have been raised from levels previously considered good to a band commonly measuring 45 to 100 ft.-candles, with 300 to 350 ft.-candles for final inspection. Reduced spoilage, greater eye comfort, a high degree of uniformity in light distribution, a normal fixture cleaning schedule at the end of each eight-hour shift in the finishing, drying and yarn spinning departments and a daily tube replacement patrol contribute to increased production in various departments. Useful tube life runs between 2,500 and 3,000 hours normally, departments having fewer turn-ons and turn-offs enjoying the longer service.

Windows in portions of this mill are being bricked over because modernized interior lighting insures even and reliable intensities 24 hours per day. This is a most valuable asset in the plant's heavy production of defense material.

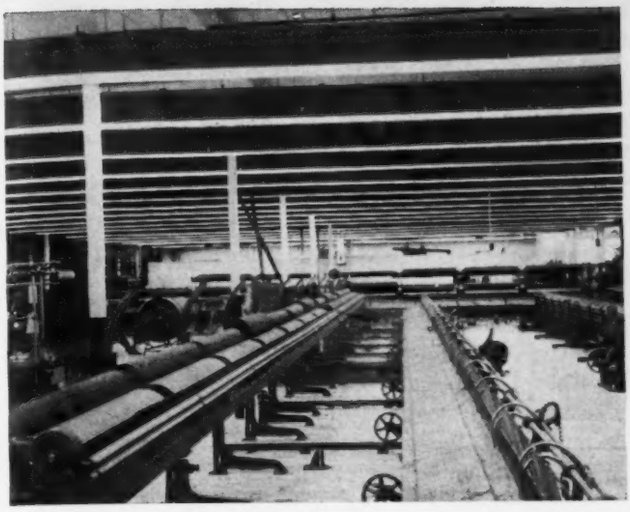
Tests showed 81 to 84 percent increase in weaving efficiency on one type of motor fabric, with a decrease of 22 percent in mending costs, due to improved lighting, and 83 to 87.7 percent increase in another case with 25 percent lower mending costs. Mill operatives' earnings also rose through easier, quicker and better processing. The Uxbridge company has found that an incandescent lighting system requires five times as many circuits and switches as a comparable fluorescent installation, larger and more wire, and bigger switch cabinets. Lamps must be replaced three to four times as often, with substantially increased energy consumption.



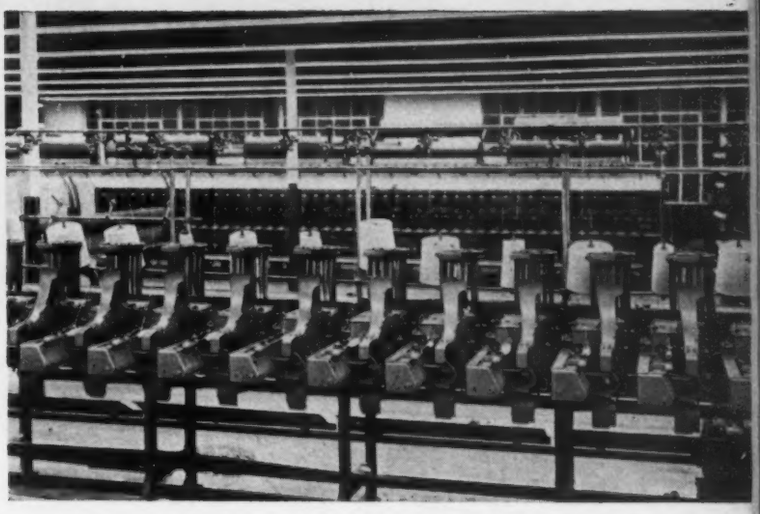
YARN DRESSING FRAME lighted by Miller CPED 248 unit between reel and beamer with two T-12, 40-watt white G.E. fluorescent tubes 8 ft. above floor; a similar unit being located over reed stand 7 ft. above floor; a third in the aisle between each pair of machines near the spool rack and above the supply of yarn spools, 8 ft. above floor, and two single 36-in. concentrating reflectors each equipped with one T-8, 30-watt white G.E. fluorescent located one on each side and at the top of the spool rack (9 ft. above floor) to light down the sides of the yarn spools. Intensities are 40 ft. candles on yarn feeding upon the beamer, 50 to 65-ft.-candles at the reeds and 45 to 15 ft.-candles on the spools in the rack from the top to the bottom spool.



RING SPINNING of wool yarn under intensities of 25 ft.-candles vertical at spindles 30 in. above floor, 45 ft.-candles at lower rolls 42 in. above floor and 55 ft.-candles at top rolls 54 in. above floor. Old incandescent system gave 5, 11 and 15 ft.-candles at these levels. Still better results are obtained by mounting fluorescent tubes in troffers located perpendicular to center line of frame, now made standard for company's future installations. Miller troffer sections carry 40-watt, 48-in. white tubes.



MULE SPINNING lighted by troffers run at right angles to machine center lines, intensities being 35 ft.-candles at spindles 20 in. above floor and 45 ft.-candles at back rolls 30 in. above the floor. Old lighting was by 100-watt tungsten lamps in shades with 8x8-ft. spacing and 9-ft. mounting height, giving 10 ft.-candles at spindles and 12 at back rolls.

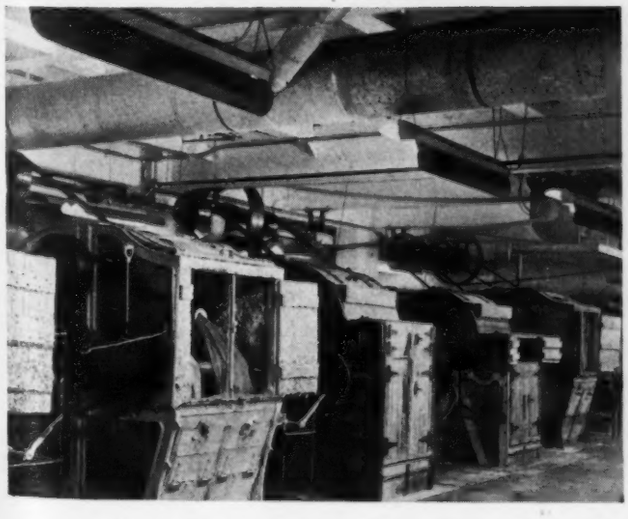


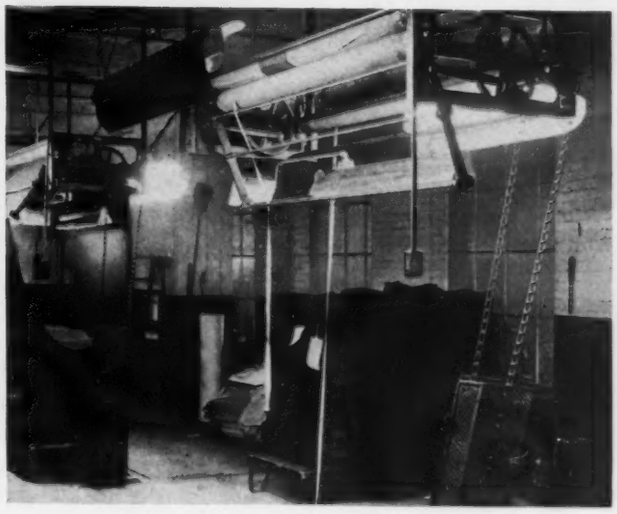
TEXTILE FILLING WINDING to loom bobbins from cone or tube packages. Machine is in area 152x50 ft. lighted by 45 rows of Miller troffers, each having twelve 48-in. sections 48 ft. over all. Each row has twelve T-12, 40-watt white tubes. Troffer rows 6 ft. on centers, 9 ft. above floor. Intensity 45 ft.-candles at winding bobbins, 48 at top of yarn packages, after 200 hours operation. Troffers and tubes are blown off by compressed air every eight hours and washed weekly.

→ LATEST PERCH LIGHTING, 275 to 350 ft.-candles on working area, 12 watts per sq. ft., five double fluorescent units per perch (two 40-watt tubes per unit), 30-deg. angle from vertical at board surface. Six units used on wider perches. Quality of light admirable for final inspection. Tube battery 3 ft. and 5 ft. from perch at top and bottom.

FULLING MILLS, normally operated with doors closed, are illuminated by units in front of each mill, 7 ft. above the floor. Two 40-watt tubes deliver 30 ft.-candles upon the mill interior when scrutiny of material in process is required. Daylight tubes provide for close inspection of color conditions.

FOLDER TAKE-OFF for cloth coming up through floor from drier, each machine equipped as follows: Two Miller CPED 248 units, each having two T-12, 40-watt white fluorescent tubes located one unit on each side of the cloth, 7 ft. above floor and tilted 45 deg.; in center between two lines of cloth is a Miller Alzak PJAC 148 with one T-12, 40-watt white tube 5 ft. 6 in. above movable 10-in. cloth platform. Intensities are 90-100 ft.-candles on cloth at eye level (same at cloth folder); 50 ft.-candles on folded cloth and 75 to 40 ft.-candles for cloth on inside according to height above cloth platform. Old lighting four angle-type reflectors, 100 watts each. Decrease in wattage per take-off from 400 watts to 250 watts, lighting intensity up 100 to 150 percent.





Editorials

S. B. WILLIAMS, *Editor*

Wasteful Use of Raw Materials

EACH MONTH brings new restrictions in the use of raw materials and more are coming. So critical has become the supply of some materials that there is a question in the minds of some people whether we will have enough even for our war machine. The answer is that we will not have enough if we persist in using raw materials as we always have used them.

Every industry has certain standards for construction, based frequently not on what is a minimum but what will give plus life, or safety or service. Often these are based not on known factors of safety, but on estimates which have unkindly perhaps, but nevertheless truly, been called factors of ignorance.

What do we known in the electrical industry, for instance, about the minimum safety of some of our construction? Do we truly know how light we can safely build a switching station? What basic safety data do we have on the wall thickness of inclosures, be they raceways, boxes, cases or metal clad? When we went from $1,400 a mile rural construction to $800 a mile or less, how much did we sacrifice in customer service?

But even if the industry did set up standards of size and safety for a great many products, and even if these were not always true minimums, but the result, ofttimes, of compromise, even then a great many users and regulatory bodies were not satisfied but had to have something better. They may have had excellent reasons from the standpoint of extra life, greater safety and better performance over the life span, but the fact remains that the extra-standard equipment did use more raw material.

Deluxe specifications may be all right in a peacetime economy, especially in a country of normal plenty, such as the United States. In a war economy, where every pound of material counts, they cannot be permitted.

We do not have the time now to make a basic investigation of what constitutes minimum standards, but every manufacturer and every user and every agency regulating the use of electrical equipment and supplies has the responsibility to question the specification of anything that is in excess of industry minimums. In fact, no construction specification should be accepted today until the engineers have satisfied themselves that every pound of material that can be cut out has been eliminated.

It is immaterial today whether a new line will last fifteen years or thirty. If considerable material can be saved, then there is no justification for the longer life specification. That may seem like heresy to a great many power company managers and engineers, but perhaps a little heresy now may give us the opportunity to be more godly later.

Not only does this necessity hold true for new work but for existing equipments as well. We must get all that we can out of existing equipment short of destroying it. In fact, there is a dilemma here from which there is no escape. We must not only get all we can out of equipment but we must carefully protect the operability of that equipment.

Nothing must be thrown away that can be used, yet every bit of metal that cannot and will not be used must quickly find its way back to the melting pot. Stuff that has been written off the books but is still in existence must now be reappraised. Can it be used? Is there a possibility that it may be needed? If so, keep it and put it in condition. If not, sell it for old metal.

Spot checks have indicated to WPB that the greatest expansion in our stock of raw material will come not so much from new mines as from a more intelligent management of what we have. A large percentage can be added to our visible supply by thrift.

While this is a problem for every individual company, it is also a matter for coordinated action by industry representatives—and the time to do it is now.

Reduction in Street Lighting Gives No Raid Protection

THERE has been a wave of reduction of street lighting brought about by the mistaken impression that it was a means of improving air raid protection. The general practice in these instances has been to turn out every other lamp.

A few minutes of calm thought would show that turning out every other lamp would be of no value whatever as air raid protection. Even turning out three out of four would be of no value, because the pattern would still exist and the amount of light would be easily visible at 10,000 feet and higher.

What does happen, however, is that the protection to the pedestrian and the automobile driver is greatly lessened and the cost to the taxpayer, because of more accidents, is increased. This is no longer a theory. It is a fact proved by a great array of facts.

The first set of extensive and well-organized facts came from Detroit, where just such an instance occurred. As a means of depression economy street lighting was reduced. The accident rate shot up. Then the lighting was restored and the rate fell. Since then these data have been confirmed in numerous cities.

But if these data are available, why don't they get

into the hands of these misguided municipal authorities and the local newspapers? Somebody must take the responsibility to see that the cure is not worse than the bite and that local responsibility must rest with the local power company.

Sure there will be some people who will think that all the power company is interested in is its revenue, but when the utility can show facts that others have gathered—principally traffic engineers and insurance companies—it would seem as though the utilities ought to be smart enough to turn this knowledge into a public service, and in such a way as to get the thanks of the community.

Material Shortages Boost Bare and Covered Neutral

BARE NEUTRAL WIRING may yet get National Electrical Code recognition. L. J. Rosenwald, chief of the Bureau of Industrial Conservation, WPB, has recommended to the Electrical Committee, NFPA, that consideration be given to the approval of bare neutral and also of covered neutral wiring.

This latter type has been permitted for several years as trial installations. Bare neutral has never made the grade because of opposition from several sources, the strongest being from the water works people, who fear troubles from grounding to the water pipes.

These two forms of wiring have been promoted by the power people on the basis of saving in cost because of the smaller material content. Those who install wiring and others have not been satisfied that the saving, if any, is sufficient to warrant accepting the system.

Now, however, the element of lower installation cost is not considered. It will save materials, says WPB, and therefore it is a good thing. Of course WPB will not want to see the use of bare neutral or covered neutral adopted if it means a decided increase in the hazard. But does it? Who knows?

This whole matter will come before the proper code article committees at an early date, when there will undoubtedly be an inclination to give approval as a patriotic measure, especially as the methods and materials have for some time had enthusiastic backers.

To do that, however, in our opinion would be a mistake. Codes cannot be made out of patriotic emotions. If by this time sufficient members of the Electrical Committee have become convinced that these systems warrant Code adoption without regard to material shortages, well and good. If not, some way should be found to make their use possible under certain restrictions without actually recognizing them in the Code.

Of course, such permission will bring a much larger usage than would come out of a normal trial installation, but that may be of advantage in that it will furnish evidence in sufficient volume and over a wide enough area to indicate what, if any, hazards are inherent with bare and covered neutral that do not exist with insulated systems and what are the needed regulations.

Spares Need Test as Well as Care

KEEPING a stock of replacement parts is smart practice in these days of overloading and of delays in getting supplies. But for equipment that can deteriorate, particularly in electrical insulating characteristics, it is equally smart to watch the material so it will be ready for instant use—the purpose for which it is kept in stock.

Stockrooms can be and many are models of housekeeping and orderliness. Supplies are likely to be fully protected from the elements that affect working equipment exposed to the weather. Dirt and dust can be kept from accumulating on surfaces. Moisture and heat ought to be under reasonable limitations of range.

But are they? Of course, these are ideal conditions and, of course, they do not exist in every stockroom. But why should material in a stockroom be pampered when out on the line it gets all the rough-and-tumble of the elements? The difference is that the equipment out on the line is energized, while that in the storeroom is unenergized. With that difference recognized the matter of absorption of moisture has new meaning for stored insulating parts.

Experience has shown that it is not well to assume that orderly kept equipment in the storeroom is always ready for instant service. It would be well to give it a leakage test, give it a power factor test or give it a flashover test—whatever is necessary to insure that, electrically, it has not suffered more loss of properties than it might even have suffered in normal service.

Otherwise, the respect for the storeroom may tempt the operator to trust too implicitly in an emergency upon parts that may prolong an already undesirable outage.

No Appliance Sales Survey For the Duration

FOR SEVERAL YEARS in March ELECTRICAL WORLD has carried an Appliance Sales Survey in which were analyzed the sales results on several kinds of electrical appliances both by utilities and by dealers. Attention was also given to those operations in communities where all of the sales were made through the dealers.

These surveys in the past have been used by a great many utilities in setting up sales programs and in checking performance against other properties. This year, however, the results of last year can be of no value in gauging future activities. For that reason the survey will be discontinued until such time as the character of the market warrants it. In the meantime we wish to thank all of those who cooperated by furnishing the data.

Like the Appliance Sales Survey, other studies and features may be dropped this year. The fact that a special feature has been established through the years will not be, of itself, sufficient reason for its continuance. Rather we shall, as we have done already this year, gear our special features to the conditions of the times.

Washington Comment

By GEORGE E. DOYING, Jr., Washington Correspondent

Public Power Trust Overlooks No Bets

THERE'S A SAYING in Washington that whenever President Roosevelt delegates authority an unwritten parenthetical reservation always goes along—(except as to electric power). It's one of those bright quips which often have some truth behind them.

Little more than a month has elapsed since the President delegated to Donald M. Nelson "full responsibility" and "final authority" over all war production, and implemented that delegation with an executive order directing federal agencies to comply with Nelson's policies. The New Deal public power trust is not abiding by that injunction from the White House; instead it is still jockeying for position and bidding energetically for enlargement of public power on the coattails of the war program.

Grand Game of Grab

It's not so much that the public power trust is seeking to take away from Nelson the authority granted him, although ambitions along this line still are being nursed assiduously. The line of attack is to attempt to grab the new power generation to be installed for war purposes and to clog the War Production Board's desk with recommendations and proposals for meeting the war program requirements. In other words, the public power trust doesn't particularly mind letting Nelson and WPB Power Chief J. A. Krug make the decisions, just so long as those decisions favor the proposals advanced for more public power. Wherever the public power trust's plans aren't swallowed whole, the cry is at once raised that Krug's $1-a-year men—or Krug himself—are tools of the utilities.

That's the strategy—Nelson can remain a figurehead boss in planning electric power if he will see to it that the war program is warped to promote more generating and transmission facilities for the public power trust.

Internally, the public power trust is a house divided against itself, but externally there is no division on the issue of continually discovering power shortages and war energy needs to get more federal money to build facilities in competition with utilities—heedless of Nelson's policy that there is neither time nor materials to permit construction of unnecessary new facilities for war production. At least four distinct camps of public power trusters are seeking to guide Nelson's hand on war energy matters.

Secretary Ickes is one of these, and his self-assigned domain is all expansion west of the Mississippi. His newly created War Resources Council, headed by the astute ex-Ickes publicity chief, Michael Strauss, is ready to develop at the drop of a hat a plan to meet any given set of circumstances. Only this week this council proposed a "sample list" of seventeen major hydro and steam projects to provide energy for developing the West's low-grade mineral resources. This was outlined for Senator O'Mahoney, whose chief interest is getting the West a bigger place in the war business sun.

Eager and Willing REA

Another outfit which is ever eager and willing to build anything which needs to be built to get power, temporary or otherwise, to a war plant, without regard to what facilities may already be available, is the Rural Electrification Administration. Witness, REA's various ambitious plans for serving the Arkansas aluminum plant discussed on this page February 7, or its frantic efforts to build transmission lines to carry the Possum Kingdom dam energy in Texas to a few small plants with defense orders and, coincidentally, to a number of REA distribution co-ops.

This Texas line has got REA into trouble with defense authorities; the Army formally protested to the War Production Board that it violates Priority Order P-46. Outcome of this brush between the Army and REA was a WPB ruling this week that the line does violate P-46.

Chairman Leland Olds of the Federal Power Commission is another who wants a hand in running the power program during the war period. He has overlooked few opportunities to emphasize that FPC has certain statutory authority in wartime and to relate what the commission is doing or is going to do to get the job done. While the FPC chairman is actively bidding for the right to help run the show his way, it is important to note that this attitude is not that of the commission as an agency so much as it is that of Olds as chairman of the agency.

Remarkable Coincidences

Finally, there is the Congressional power bloc, which is being aided and abetted by the White House. This group is operating on the theory that the war has produced an open season on federally financed power projects. All of its projects are advanced as providing "vitally needed" war energy, but, curiously, each of them happens to fit the public power promotion schemes of the sponsor. The Arkansas Valley Authority is an example among many.

The coincidence with which all these proposals for meeting war necessity also happen to further the public power trust's plans for developing federally financed competitive energy in fact, is the one common denominator of all the proposals, from Congress, from Ickes and from REA. Perhaps there is a lesson for utilities in this—the public power trust is overlooking no bets for advancing its program by patterning its immediate steps to what it conceives to be war needs. It actively seeks war business; it's easy to camouflage this as patriotic service, a fact which sometimes makes it hard for WPB, pressed by the bitter need for getting production, to turn it down.

NEWS OF THE WEEK

WPB Declares Texas Coop Violating Priorities

Holding company cooperative prohibited from completing 600-mile system — Decision intended as authority over growing public power trust — Estimates of completion heavily "loaded"

The War Production Board this week formally declared the Rural Electrification Administration's "holding company" co-operative in Texas guilty of violating priority regulations and wartime policy prohibiting construction of duplicating electric facilities (ELECTRICAL WORLD, February 14, page 3).

WPB further directed a program for utilization of Possum Kingdom hydro energy, which REA has purchased, so that power not required to serve the loads of the "holding company" co-op's members will be transmitted over Texas Power & Light lines to the Lower Colorado River Authority for serving the latter's magnesium loads.

This halts REA's program of constructing a 600-mile transmission system criss-crossing T.P.&L. lines, with which the "holding company" co-op could bid for war business with its surplus energy in competition with T.P.&L.

Accepting, however, the realities of the situation which finds a portion of the REA transmission network already virtually finished, WPB ruled that the agency may complete specified portions so as to "afford the maximum utilization of all power facilities and at the same time conserve critical materials." Portions of the program which may be finished already were 85 to 95 percent completed, in violation of priorities before WPB halted construction.

On the thread of this Pyrrhic victory, REA Administrator Harry Slattery issued a statement in which he termed the WPB action "vindication" of REA's contention that additional energy is needed in Texas for war production, and promising to rush completion of the portions approved.

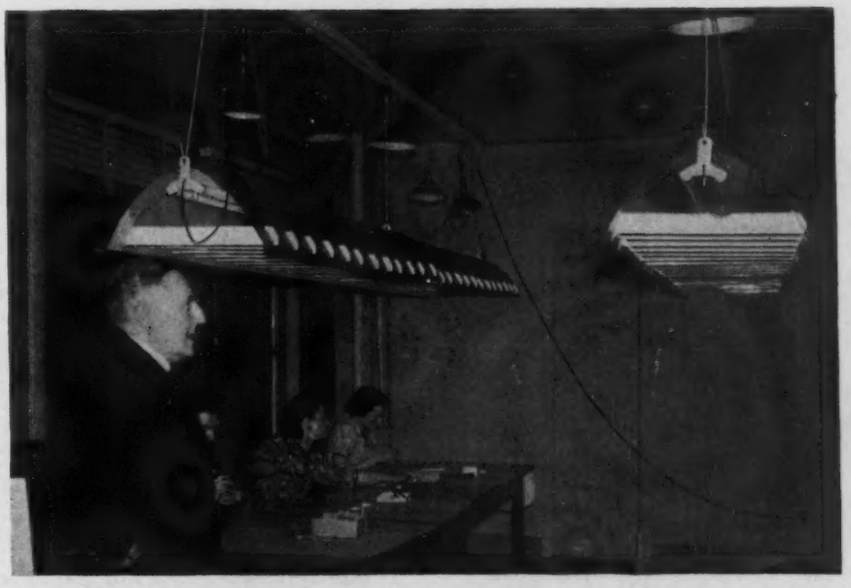
The decision is an important precedent and is intended as WPB's assertion of authority over the New Deal public power trust (see page 70, this issue).

Here's what the decision, issued in a letter to Brazos River Transmission Electric Cooperative, Inc., does:

1. Finds that the co-op violated Priority Order P-46 by continuing construction of the transmission network with the required WPB approval of new construction costing more than $500 or extending more than 1,000 feet not 40 percent or more finished on December 5, 1941.

2. Rejects completely REA's contention that the project was 43.6 percent finished by computing as expended costs attributable to office, legal, engineering, right-of-way, contractor's overhead and profit, labor, material and equipment in storage, in transit and even in process of fabrication in suppliers' plants.

3. Permits completion of the 66-kv. line from the damsite to Garland and one 33-kv. spur line, with necessary substations. WPB stated this permission was granted only to make "effective use" of construction practically com-



PRESSBOARD LIGHTING UNITS—Experimental industrial fluorescent lighting units made from pressboard commonly used in motor slot insulation were displayed as a possible temporary wartime substitute for steel units at the Chicago Lighting Institute's recent "Lighting for Defense" School by E. D. Tillson, Commonwealth Edison Co. (left). The four 8-ft. sections shown would probably retail for around $80.

POWER TRANSFER SPECIALISTS—Leaders at annual meeting of New England System Operators, held February 12 in Boston. Clarence W. Mayott (rear row, left), manager Connecticut Valley Power Exchange and Consultant in the Power Branch of WPB, stressed the increased utilization of hydro and steam generating capacity achieved through co-operative use of utility and governmental facilities during the recent southeastern states' drought. Arthur B. Guise, chief engineer Rockwood Sprinkler Co. (rear row, right) discussed fire protection by the spray nozzle method, as a safeguard to vital substation and other plant operation. Front row, left,-Harold L. Durgin, chief engineer Central Vermont Public Service, retiring chairman, and William B. Carnie, chief system operator, Montaup Electric, Somerset, Mass., chairman-elect. Back row, center, Donald P. Reed, assistant chief load dispatcher, New England Power System, Millbury, Mass., secretary-elect

plete. Authority to build 330 additional miles of spur lines and fifteen other substations was denied and the co-op ordered to abandon work done.

4. Specifies that energy from Possum Kingdom not needed to serve the distribution co-ops he made available over T.P.&L. lines to the Colorado Authority for magnesium production.

5. Specifies that T.P.&L. and REA work out arrangements whereby Possum Kingdom energy will be supplied the company in exchange for its own energy required to serve the distribution co-ops to which the transmission line is being denied.

The decision marks the second time in recent weeks that WPB has forced integration of public and private facilities to handle war power loads. Previously, the agency "merged" competing proposals of REA and utilities for serving the Arkansas aluminum plant to provide for pooling of a government dam for peaking purposes with utility steam stations.

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WPB Asks Modification of N.E. Code Provisions

The Bureau of Industrial Conservation, WPB, has asked the electrical committee of N.F.P.A. to aid in the conservation of rubber and copper by substituting the 1937 ratings in place of the allowable current-carrying capacities of conductors given in the 1940 edition of the National Electrical Code.

The bureau has also asked the electrical committee to approve covered and bare neutrals and upon approval to place the bureau's recommendations into effect immediately.

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WPB Order to Build Up Fuel Inventories

Large users of coal and coke, especially utilities and industrial users, are being urged by the WPB Division of Industry Operations to build up their inventories as much as possible to avoid the danger of having to suspend operations in case of an emergency.

General Inventory Order M-97, issued February 13, revokes the inventory restrictions imposed by Priorities Regulation No. 1 in so far as they apply to coal and coke.

The order will enable large users to take advantage of the fact that there is at present considerable excess production of coal and coke and transportation available for distribution of these materials.

Inventory restrictions are relaxed for coal and coke only. Inventories of all other materials must be kept to a practicable working minimum in accordance with the terms of Priorities Regulation No. 1.

NEWS BRIEFS

SAN FRANCISCO OFFICIALS, convinced that in view of President Roosevelt's pronouncements on the subject Congress will not vote to amend the Raker Act, are discussing with Secretary Ickes ways and means of using Hetch Hetchy power for defense industry purposes.

ELECTRIC SIGNS would be extinguished for the duration by Lieut.-Gov. Charles Poletti of New York to "conserve power," declaring that power serving 150,000 kw. of sign load in Manhattan "could produce 150,000,000 lb. of aluminum."

SMALL APPLIANCE MANUFACTURERS are expected to receive a dispensation from WPB permitting them to operate through June in order that they may clean up production on partly fabricated products. For this reason no shortage is seen this year in minor appliances.

WISCONSIN ELECTRIC POWER Vice-President Frank A. Coffin told an annual gathering of 1,000 electrical appliance dealers that, in so far as it was consistent with the nation's war effort, the company will continue its advertising and other promotional efforts.

ONLY SIX OPERATING COMPANIES grossing more than $10,000,000 annually are reported to have an increased net for 1941. Here they are: Alabama Power, Consolidated of Baltimore, Georgia Power, New York State Electric & Gas, Puget Sound Power & Light and Union Electric of Missouri.

A DIRECT THROUGH LINE from New York City 300 miles to the Massena aluminum plant would be unduly extravagant with respect to construction materials and emergency losses, the New York Public Service Commission has been advised by its engineering staff. The latter recommends speedy power supply with war-time economy through the construction of three short transmission links and use of present public utility systems.

REGULATIONS AGAINST NON-UNION workers were dropped by the Philadelphia Brotherhood of Electrical Workers, A. F. of L. affiliate, and temporary work cards costing one dollar per day were passed out to non-union workers.

Blackout Developments Feature T & D Sessions

Buffalo, Rochester, Philadelphia and Nela Park experiences cited—Salvage substitutes and conservation are topics at two-day Cleveland meetings

No less than nine hours of afternoon and evening sessions was devoted by the E.E.I. transmission and distribution committee at its Cleveland meeting February 9 and 10, 1942, to discussing the problems of blackouts.

Buffalo reported installing 10-amp. key switches in condulets to control street lights after finding that pilot wire and cascade controls would require substantial quantities of scarce materials. Rochester and Philadelphia reported trial blackouts dropping load at rates of 10,000 kw. per minute.

Technical background for effective but safe blackout lighting was demonstrated to the 100 in attendance at Nela Park, with Kirk Reid and several associates developing the principles from a threshold angle. New foot-lambert meters and graphic charts were shown as tools of the new reversed promotion of "low visibility up above coupled with high visibility down below."

Conservation Sessions

Conservation of man-power and of critical materials motivated most of the other sessions. G. R. Sutherland of WPB gave, in an informal talk, indications of forthcoming procedures with regard to disposition of scrap, obsolescent materials and surplus stocks. He urged a search for a substitute for standard solder and recommended preparation of a handbook of salvage technique. Uncovering and "loosening up" dormant scrap is the immediate and urgent objective.

Despite the availability of the new E.E.I.-NEMA standard transformers, the industry, according to H. M. Jalonack (General Electric) used 925 tons of iron crossarm hangers in 1941 versus 890 tons in 1940; direct bolting to poles now would save 1,000 tons annually. Elimination of taps would save 56 tons of non-ferrous metals, 15 tons of plastics, 75 tons of porcelain, 19 tons of steel, 30 tons of miscellaneous insulating materials and 83,000 man-hours, he averred.

Significant examples of framed-wood towers and substation structures were shown by Ben Hughes (Hughes Brothers), H. N. Fox (Commonwealth & Southern) and Frank Kendig (Dayton) after H. J. Henderson (Ebasco) had enumerated the following opportunities for wood to replace steel: Poles, pins, brackets, extensions, wishbones, braces, racks, goosenecks, pole-steps, guy guards, anchor "dead-men," etc. He also mentioned live-line tools in lieu of rubber gloves.

Some degree of assurance was given by W. W. Satterlee that the new Westinghouse air-cooled transformer can be evolved into a submersible form. Some 125,000 kva. are working in commercial and industrial plant service.

Detroit salvaged 213 tons of lead sheath in installing the 35,000 ft. of 120-kv. 600,000-cir. mil cable in the 7½-in. steel pipe under nitrogen pressure. By careful planning of the filling operation about 150 tanks of gas also were saved. M. W. Ghen (Duquesne Light) reported laboratory cable-movement tests which showed that rigid arcproofing, by preventing concentrations of stress in the manhole (even though with duct snaking) gives sheath life ten or more times that of unarcproofed cables.

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Contracts Awarded for Massena Link

Contracts have been awarded for the construction of a 230-kv. transmission line to be built from the Taylorville substation of the Central New York Power Corp., near Belfort, N. Y., to supply power to the aluminum plant of the Defense Plant Corporation, now being built near Massena. Contracts were awarded to the Miller Construction Co., Inc., Indianapolis, Ind., and to the Robert E. Foley Construction Corp., Binghamton, N. Y., on their bids of $594,687 and $374,571.50, respectively.

The length of the lines will be approximately 77 miles and two 230-kv. wood-pole lines will be built on a 250-ft. right-of-way. Center lines of structures will be spaced 100 ft. Wood-pole H-frame structures having 50-ft. Douglas fir arms will be installed. Class II poles will be set 24 ft. apart, which will be also the conductor separation. Flat configuration will be used and normal span length will be 500 ft.

Conductors will be of the hollow type, 1.1 in. diameter, 500,000 cir. mil cross-section. Two ground conductors will be installed on each line of structures and for this copper-covered steel strand consisting of three No. 5 30 percent conductivity wire will be used.

Insulator strings of fifteen 5¾-in. units will be installed on tangent structures. Seventeen units will be installed at strain positions, in double strings. Construction is scheduled for completion by May 1, 1942.

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Tire Retreading Goes Under Ban

Retreaded and recapped tires, including the retreading and recapping of tires now in use for the owner, now are under virtually the same rationing restrictions applicable to new tires.

Trucks and buses which have been eligible for new tires are eligible for certificates for retreads under the same conditions and from the same local boards; tires for such vehicles still must be retreaded as often as possible before a new tire replacement is sought. Passenger vehicles eligible for new tires will be given only "new tire" certificates so long as quotas last and will not be required to retread their tires first. This arrangement is to spread the limited amount of camelback rubber for passenger car retreading as far as possible among vehicles which are not eligible for new tires.

A secondary list of essential passenger car and truck uses not eligible for new tires is, however, made eligible for retreads as supplies are available. Included here are such vehicles as taxis, individual autos used by war workers, etc., to drive between home and factory, and "trucks used for any important purpose not included in List A (new tire list)."

Passenger cars used for pleasure and non-essential business driving are not eligible for retreads, nor for retreading materials even for the tires now being used on them. Rationing Administrator Henderson explained this step was required because "with no restriction on retreads, pleasure cars and other unimportant vehicles have overburdened retreading facilities and crowded out workers in war plants."

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Protective Devices Uses

Under the rigid control of the uses of crude rubber and latex recently announced by WPB (ELECTRICAL WORLD, February 14, page 7), certain industrial protective devices received favorable treatment. Rubber may be consumed each month for industrial protective clothing at 100 percent of the base period—twelve months ended March 31. Latex may be consumed for electrician's and industrial gloves (without fabric) at 100 percent.

Propose Huge Expansion of Government Projects

Bonneville five-point plan involves addition of 1,200,000 kw. — Secretary Ickes' plan contemplates 1,480,000 kw. from 17 hydro and steam plants, to cost $351,000,000

Two separate proposals for huge expansion of government power plants in the far West were disclosed this week in Washington.

One was the formal recommendation by the Bonneville Advisory Board, a planning agency representing several government departments, to the War Production Board of a five-point expansion or acceleration of existing power construction to add 1,193,000 kw. of capacity in the Northwest within two years at a minimum cost in materials and machinery.

Ickes Plan

Second was the advancement of seventeen hydro and steam projects with a total of 1,480,000 kw. of capacity at a cost of $350,603,000 by Secretary Ickes as a "by-product" to an elaborate report outlining a vast mineral development program. This report went to Senator O'Mahoney, chairman of a subcommittee seeking means of getting the West a greater share in war business.

The advisory board's proposals came after a two-day study of the power requirements and supply situation in the Northwest at which representatives of defense and other interested agencies were consulted. Part of its program already has the approval of WPB and the rest probably will get approval as energy supply is needed for additional war production.

Bonneville Proposals

Recommended by the board were these steps:

Expedite installation of remaining generators for Grand Coulee's left power house and proceed with plans for the first three units in the right power house now being built. (Two 108,000-kw. units are in service, a third nearly ready and six more have WPB approval. Another one or two would exhaust Coulee's firm energy capacity.)

Expedite installation of the last four units at Bonneville. (This also has WPB approval.)

Raise Seattle's Ross Dam on the Skagit River by 183 feet to provide 79,000 kw. additional firm capacity without additional equipment.

Complete Puget Sound Power & Light Co.'s Rock Island dam, installing eight more units aggregating 160,000 kw., with the government taking whatever steps are necessary if the company cannot finance the work.

Expedite construction of Tacoma's Nisqually project to produce 90,000 kw.

WPB has not formally acted upon the last three of these projects, but can be expected to favor them as its own studies show additional energy is required in the area.

In addition to this specific program, the board urged that all federal agencies interested in power projects in the Northwest complete within 90 days plans for any construction which can be quickly done without excessive use of materials. A dozen projects with a potential 4,000,000 kw. of capacity were discussed during the board's sessions, but no action was taken and there is no indication that WPB presently is looking for additional energy in that region, beyond that now planned.

Ickes' report to Senator O'Mahoney is the work of the Secretary's newly created War Resources Council, of the Interior Department, headed by Michael Strauss, formerly Ickes' publicity chief. Bulk of it proposes various explorations for mineral deposits, pilot plants to test new mining techniques, and, in a few instances, large-scale production of metals needed for war material.

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Price Ceilings on Gearing and Pinions

Gears, pinions, sprockets and speed reducers have been placed under formal price "ceilings" by the Office of Price Administration. All maximum prices are tied to October 15, 1941, levels. The schedule, identified as No. 105, became effective February 18.

Three classifications are set up by the order covering all the products listed. These classes are: standard, recurring specials and special items.

Standard items are those in price lists in effect October 15, 1941, and price maximums are those prevailing on that date, less all applicable discounts then in effect.

Special items are those never produced before; prices for these must be computed on the basis of October 15 labor and material costs and by use of estimating methods and price-setting standards in effect as of that date.

Recurring specials are items for which two orders have been or are received subsequent to February 18, 1941. First sales of such items after February 18, 1942, shall be priced as "special items" and that price becomes the ceiling for subsequent sales.

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PD-200 for Utilities on Project Ratings

Utilities seeking project priority ratings for new construction should now apply to the Power Branch on Form PD-200, obtainable from Washington or any field office. It is still advisable, in addition to filling out PD-200, to supplement the application with data previously called for by the Power Branch and in the form called for. (See ELECTRICAL WORLD, January 10, 1942, page 43).

Form PD-200 is the standard form prepared by the War Production Board's Priorities Division for project applications from all industries. For a long time the Power Branch continued use of its own application procedure which had been developed prior to PD-200. Use of the standard form, however, is being made compulsory in anticipation of a shift in priority procedure in which project ratings will be awarded only for specified amounts and types of materials listed by the applicant as necessary for the job on PD-200. This development is coming to give WPB greater control of the flow of raw materials and a specific check on amounts of materials which have been allocated.

Project ratings still are sought for all utility construction involving expenditure of more than $2,500 for materials (exclusive of installation labor), or more than ten suppliers. Construction involving less than $2,500, but in excess of the $500 limit provided for under P-46, still is given priorities through use of the PD-1 or PD-1-a form, use of the latter becoming mandatory after March 1. An effort is being made to develop an all-industry "short form" for small construction, probably jobs costing less than $15,000. When this goes into effect—it has not been worked out yet—it will replace use of PD-1-a forms on all capital improvements.

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Consider Eliminating Utilities Commission

Elimination of the public utilities commission in British Columbia for the duration, as a war economy, is being strongly advocated in the B. C. Legis-

lature. Two different proposals aimed toward this objective have already been submitted. It is contended that with major issues of war before the country, smaller disputes, in connection with the public utilities, can be ignored for the time being and money saved to be used for more useful purposes than continuation of the public utilities commission during the war period.

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Refrigerator Plants Converted to War

The War Production Board's decision to convert the mechanical refrigerator industry 100 percent to war work, without a "Victory" model concentrated in one or two plants, sets a probable pattern for conversion of other durable goods industries. Several more appliance industries are soon to be converted, among them radios and probably vacuum cleaners and ranges.

Deadline for household refrigerator production has been set for April 30, with manufacturers permitted to operate at three times recent quota schedules until then to use up a maximum of inventories and to provide a government-controlled stockpile of finished units for rationing.

A "freeze" order on wholesale and retail sales accompanied the production deadline order—retailers may sell (from 10 a.m. EWT on February 14) one-twelfth as many units as in 1941, or 100 units, whichever is larger, from stock. Additional models in retail or wholesale hands are to be added to the stockpile.

Decision to convert completely the refrigerator industry, rather than continue even token production of a simplified unbranded model, came after close study of the conversion problem by WPB officials and representatives of the industry.

WPB officials estimated that the stockpile created by the retail freeze order and the stepped up production for ten weeks will total about 750,000 units. This, they believe, will be sufficient to equip defense housing units and dwelling units at permanent military camps for two years or more. Whether rationed distribution of the stockpile will be through dealers' hands or by continuation of centralized government purchasing is uncertain, but in either event dealers' business is certain to dwindle to a trickle of the boom 1941 level. Few, if any, units are to be available for civilian purchase.

Production of replacement parts is unaffected by the conversion program. It will be continued as a means of keeping presently in-use refrigerators operating for the duration.

Million Kw. of New Load For Utilities on Coast

Royer sees 700,000 kw. of added business in the Pacific Northwest and Pacific Gas & Electric expects 300,000 kw. of new war load

How priorities, allocations and limitation orders are affecting supplies of electrical materials and equipment for construction and maintenance was the major subject considered at the Pacific Division convention, National Electrical Wholesalers' Association, at Del Monte, Calif., February 5-7, with utility men participating in the program offered to the record attendance of 175.

R. E. Fisher, Pacific Gas & Electric Co. vice-president, reported that 300,000 kw. of new war-time load had located or was to locate in central or northern California, with attendant demands for electrical materials. He also stated that 90 percent of priority applications for line construction to agricultural power customers were being approved because of the billion dollar demand placed on California agriculture.

SPEAKERS AT DEL MONTE—R. E. Fisher, Pacific Gas & Electric vice-president in charge of public relations and sales (left), discusses current utility problems with J. E. E. Royer, Washington Water Power Co. vice-president and general manager, at the Del Monte, Calif., N.E.W.A. meeting

J. E. E. Royer, vice-president and general manager, Washington Water Power Co., Spokane, told of the 700,000 kw. of new defense industries being located in the Pacific Northwest to utilize Bonneville and Grand Coulee power.

O. R. Doerr, P. G. & E. general sales manager, reported on the programs initiated to mass educate the public on blackout lighting. His company has prepared two booklets, is running newspaper advertising, maintains blackout displays in district offices and issues a service interpreting local rulings in an endeavor to maintain or recapture lighting load lost due to blackouts.

Lamp Supply Adequate

That there is no occasion for public hoarding of lamps because, even with the limitations imposed on use of copper and nickel by the January 26 order, substitutes will permit the production of sufficient lamps to meet all essential uses, was the declaration of N. H. Boynton, general sales manager, Western division, General Electric Co., lamp department.

He described a new laminated wood fluorescent fixture that uses a minimum of metals which has been designed for application of a three-unit circuit that includes two 75-watt incandescent lamps for ballast.

N. J. McDonald, sales manager of Thomas & Betts and special electrical industry advisor to OPM, emphasized the need for full compliance with the priorities, allocation and limitations programs, especially as to cooperation between wholesalers, their customers and manufacturers, to insure that all orders are properly rated as to priority and end use.

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Custer to Manage Arkansas Power Pool

C. M. Custer, chief engineer of the Arkansas Public Utilities Commission, has been loaned to the operating committee of the power pool created to serve interim power to the Defense Plant Corporation's aluminum plant at Lake Catherine, Ark.

His services were requested by C. S. Lynch, executive vice-president of Arkansas Power & Light, and according to the commission Mr. Custer will "accept employment from the operating committee representing all the private utilities and publicly owned power projects which are or may become members of the pool, but he is not to become the employee of any individual utility or project."

Last Fall Mr. Custer was loaned to OPM to assist in the operation of the Southeastern power pool.

Utilities Get Stay in Ouster Case

Illinois utilities were granted a breathing spell recently when the Illinois Supreme Court granted a stay of mandate which delays enforcement of its decree that municipalities are empowered to order removal of public utilities equipment from city streets at the expiration of franchises (ELECTRICAL WORLD, Jan. 31, page 6).

The stay was granted pending an attempt to appeal to the U. S. Supreme Court by attorneys for the Illinois Northern Utilities Co. and the Central Illinois Electric & Gas Co., whose properties in Geneseo and Heyworth were directly affected by the decision.

Decision to grant a stay followed the adoption of a motion by the Springfield City Council to ask the city attorney for an opinion setting out the procedure to be followed in holding a referendum on the question of renewing or rejecting the franchise of the Central Illinois Light Co. Commissioner Harry Luers, who sponsored the motion because he said he felt the people should vote on the proposition, said that while the matter is still pending in the courts "there can be no question now of conducting a referendum."

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Urges Labor Practice Charges Be Dismissed

Trial Examiner Walter Wilbur has announced his intermediate report recommending dismissal of an unfair labor practice complaint against the Gulf States Utilities Co., Beaumont, Tex. The National Labor Relations Board's complaint was issued last August upon charges filed by the International Brotherhood of Electrical Workers (AFL). The trial examiner found that the company had not interfered with self-organizational rights of its employees and had not dominated and interfered with the formation and administration of the Gulf States Electric Service Employees' Association, or contributed financial or other support to it.

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Philadelphia Electric Presents Safety Awards

By driving Philadelphia Electric Co. automobiles without a responsible accident for periods ranging up to seventeen years, 841 employees received special recognition in the form of awards made recently at the Broadwood Hotel. In presenting these and other safety awards Executive Vice-President Henry B. Bryans referred pointedly to the fact that during 1941 there was no fatality among company employees, the best record in the history of the company.

President's Safe Driving Certificates, awarded annually to employees with an unblemished driving record of ten years or more, were presented to 231 employees, top honors going to four who have completed a seventeen-year tenure with perfect records. Plaques and honor certificates were made to winning groups in generating, substation, transmission and distribution, and other sections and departments—all based on lost-time accident records.

MEETINGS

North Central Electrical Industries—Biennial electrical convention week, Radisson Hotel, Minneapolis, Minn., February 22-25. W. A. Ritt, secretary-manager, 234 Foshay Tower, Minneapolis, Minn.

Edison Electric Institute — Accident prevention committee, William Penn Hotel, Pittsburgh, Pa., February 23-24; annual sales conference, Edgewater Beach Hotel, Chicago, Ill., March 23-27. Major H. S. Bennion, managing director, 420 Lexington Av., New York, N. Y.

American Society for Testing Materials — Committee week and spring meeting, Hotel Cleveland, Cleveland, Ohio, March 2-6; annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 22-26. R. E. Hess, assistant secretary, 260 S. Broad St., Philadelphia, Pa.

Greater New York Safety Council—Annual safety convention and exposition, Pennsylvania Hotel, New York, N. Y., March 3-6. Greater New York Safety Council, Lincoln Bldg., 60 E. 42nd St., New York, N. Y.

Canadian Electrical Association — Western members, joint meeting with Northwest Electric Light & Power Assn., Business Development Section and Commercial Section, Hotel Vancouver, Vancouver, B. C., March 4-6. B. C. Fairchild, secretary, 804 Tramways Bldg., Montreal.

Southeastern Electric Exchange—Engineering and operating section, Sir Walter Hotel, Raleigh, N. C., March 12-13; annual conference, Edgewater Gulf Hotel, Edgewater Park, Miss., April 16-17. J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta, Ga.

Oklahoma Utilities Association — Annual convention, Biltmore Hotel, Oklahoma City, Okla., March 23-24. Miss Kate A. Niblack, secretary, 625-626 Biltmore Hotel, Oklahoma City, Okla.

American Society of Mechanical Engineers — Spring meeting, Rice Hotel, Houston, Texas, March 23-25. C. E. Davies, national secretary, 29 West 39th St., New York, N. Y.

Missouri Valley Electric Association—Annual engineering conference, Hotel Continental, Kansas City, Mo., March 26-27. I. D. Pettegrew, director, 1527 Sharp Bldg., Lincoln, Neb.

Midwest Power Conference — Annual meeting, Palmer House, Chicago, Ill., April 9-10. Charles A. Nash, conference secretary, Illinois Institute of Technology, Chicago, Ill.

Missouri Association of Public Utilities—Annual convention, Jefferson Hotel, St. Louis, Mo., April 14-15. Jesse Blythe, assistant secretary, 101 West High St., Jefferson City, Mo.

Electrochemical Society—Spring convention, Hotel Hermitage, Nashville, Tenn., April 15-18. Colin G. Fink, secretary, Columbia University, 3000 Broadway, New York, N. Y.

Maryland Utilities Association — Spring meeting Lord Baltimore Hotel, Baltimore, Md., April 17. Wilson Cook, secretary, Potomac Edison Company Bldg., Frederick, Md.

Northwest Electric Light and Power Association—Engineering and operating section, Seattle, Wash., April 22-24 (tentative). Berkeley Snow, executive secretary, 707 Spalding Bldg., Portland, Ore.

Association of Iron and Steel Engineers—Spring conference, Royal Connaught Hotel, Hamilton, Ontario, Canada, April 27-28. Brent Wiley, managing director, Empire Bldg., Pittsburgh, Pa.

Chamber of Commerce of the United States — Annual meeting, Washington, D. C., April 27-30.

Municipal's High Rates Embarrass Ellis

Rep. Clyde T. Ellis, militant public power proponent of Arkansas, has written the Mayor of his home town, Bentonville, Ark., which has a municipal electric plant, suggesting a rate reduction as "I am finding myself embarrassed in the power fight" as the Bentonville rates are among the highest in the state. Pointing out that 25 kw.-hr. in Bentonville cost $2.25, while in nearby Rogers, operated by the Southwestern Gas & Electric Co., the same energy costs only $1.78, Rep. Ellis asked in his letter, "Why should Bentonville people suffer this discrimination?"

Continuing, Mr. Ellis said in his letter: "It may be, of course, that some of the revenues from the light plant at Bentonville are being used to operate the city or for other purposes. Of course, I think it is fundamentally wrong to use revenues derived from a power system to operate a city. My feeling is that any rates collected over and above the cost of operation of the plant and depreciation should be turned back in the form of rate reductions."

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H. S. Osborne Nominated for A.I.E.E. Presidency

The national nominating committee of the American Institute of Electrical Engineers has nominated Harold S. Osborne, plant engineer, operation and engineering department, American Telephone & Telegraph Co., for the presidency.

The official ticket of candidates for the offices becoming vacant August 1, 1942, includes the following for vice-presidencies: Karl B. McEachron, General Electric, vice-president, northeastern district; C. R. Jones, Westinghouse Electric & Manufacturing Co., New York district; A. G. Dewars, Northern States Power Co., Minneapolis, Great Lakes district; E. T. Mahood, Southwestern Bell Telephone Co., Kansas City, Mo., southwest district, and E. W. Schilling, Montana State College, Bozeman, northwest district.

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Files Electrical Code

An electrical code for Maryland has been filed with the Bureau of Legislative Reference by John B. Gontrum, State Insurance Commissioner. The commissioner points out that in the past the state has had no such code and expressed the belief that enforcement of the new regulations will do much toward reducing fire losses.

First Output Totals on War-Time Basis

The amount of electrical energy distributed by the electric light and power industry for the week ended Saturday, February 14, was 3,421,639,000 kw.-hr., according to the Edison Electric Institute, a decline of 53,000,000 kw.-hr. from the highest output in history, recorded a week ago.

This substantial decline is attributable at least in part to (1) the introduction of "war-time" throughout the nation and (2) the normal decline in output appearing at this season of the year.

Despite these influences, it will be noted that West Central and Southern states' output increased over last week.

The weekly output, up 15 percent from the corresponding week a year ago, continues in the so-called normal zone 14–16 percent above a year ago.

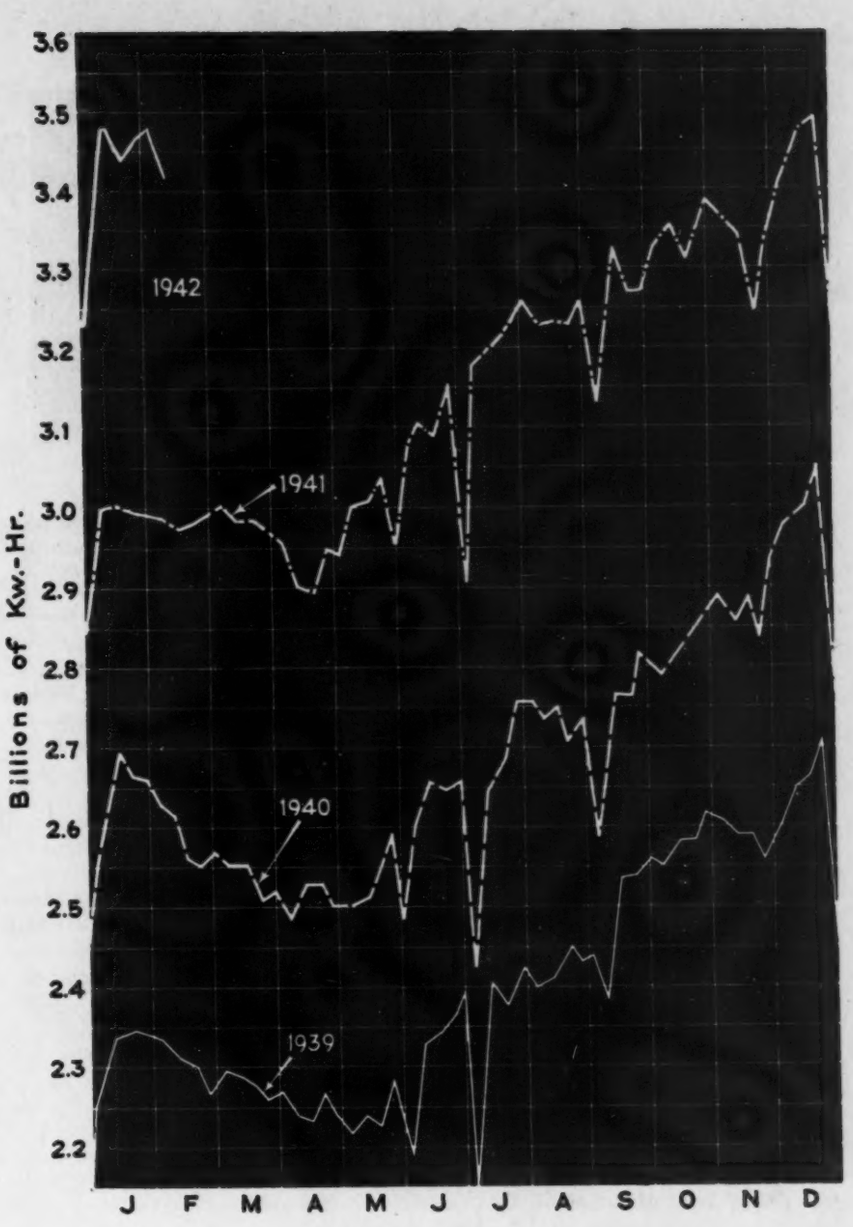
Weekly Output, Millions Kw-Hr.

1942		1941		1940	
Feb. 14	3,422†	Feb. 15	2,976	Feb. 17	2,565
Feb. 7	3,475	Feb. 8	2,989	Feb. 10	2,616
Jan. 31	3,468	Feb. 1	2,994	Feb. 3	2,633
Jan. 24	3,440	Jan. 25	2,996	Jan. 27	2,661
Jan. 17	3,450	Jan. 18	3,013	Jan. 20	2,674
Jan. 10	3,473*	Jan. 11	3,002	Jan. 13	2,688
Jan. 3	3,289*	Jan. 4	2,846	Jan. 6	2,558
1941		1940		1939	
Dec. 27	3,234	Dec. 28	2,757	Dec. 30	2,464
Dec. 20	3,495	Dec. 21	3,052	Dec. 23	2,712

Percent Change from Previous Year

	Week Ending		
	Feb. 14	Feb. 7	Jan. 31
New England	+15.3	+17.6	+18.1
Mid-Atlantic	+12.7	+14.7	+12.7
Central Industrial	+13.9	+14.4	+13.7
West Central	+14.7	+13.9	+12.0
Southern States	+15.3	+15.2	+17.5
Rocky Mountain	+16.7	+19.9	+17.9
Pacific Coast	+20.6	+25.0	+24.8
Total United States	+15.0	+16.2	+15.8

* Revised. † War-time began.



Energy Sales Rise 16.2% in November

Sales of electric energy to ultimate customers during the month of November totaled 12,288,264,000 kw.-hr., compared with 10,576,643,000 in November, 1940, an increase of 16.2 percent, according to the report issued recently by the Edison Electric Institute. Water power plants generated 4,085,777,000 kw.-hr., compared with 4,033,890,000 kw.-hr. in November, 1940, an increase of 1.3 percent. In October energy generated by water power plants advanced 14.8 percent over the preceding year.

Revenue from ultimate customers amounted to $233,962,800, against $214,160,800 in November, 1940, an increase of 9.2 percent. The number of customers as of November 30, totaled 31,530,857, compared with 30,138,494, an increase of 4.6 percent.

The average annual bill for residential or domestic service for the twelve months ended November 30 amounted to $36.76, compared with $36.48 for the preceding year. Revenue per kilowatt-hour amounted to 3.74 cents, compared with 3.86 cents for the corresponding twelve-month period, a decrease of 3.1 percent. Average annual use advanced from 945 kw.-hr. to 983 kw.-hr. in the twelve-month period.

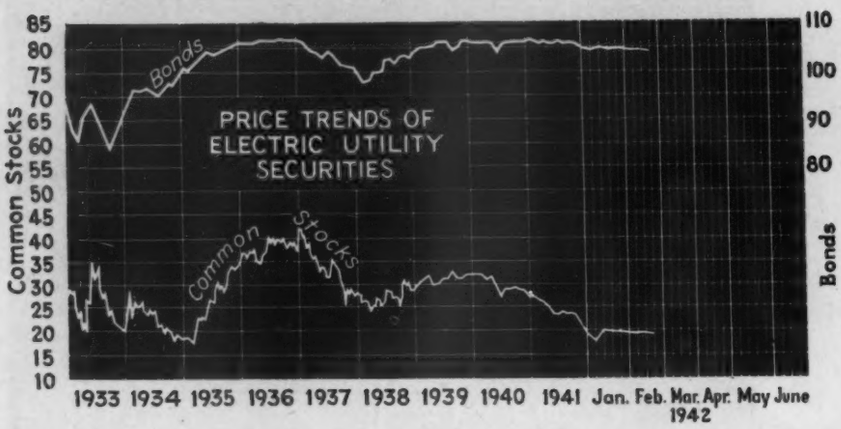
Classification of Sales, November, 1941 and Change From 1940

Kilowatt-hour Sales—During month of November	Million Kw.-Hr. 1941	1940	% Change
Residential or domestic	2,266	2,093	+ 8.3
Rural (distinct rural rates)	169	131	+29.4
Commercial or industrial			
Small light & power	2,163	1,969	+ 9.8
Large light & power	6,652	5,379	+23.7
Street & highway lighting	205	201	+ 2.3
Other public authorities	281	236	+18.8
Railways & railroads			
Street & interurban	327	338	— 3.3
Electrified steam	175	165	+ 5.8
Interdepartmental	46	60	—23.1
Total to ult. customers	12,288	10,576	+16.2

Co-Op Drops Extensions

Marathon-Portage Electric Co-operative has announced that for the duration of the war it will suspend all further activities on its project of supplying electricity to southeastern Marathon and northeastern Portage county farms in Wisconsin. The co-operative had planned to purchase electricity from the Wisconsin Public Service Corp. and had arranged to tap the utility's power line 2 miles north of Knowlton.

Utility Stocks Drop; Bonds Also Decline


PRICE TRENDS OF
ELECTRIC UTILITY
SECURITIES
Bonds
Common Stocks
Common Stocks
Bonds
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
1933 1934 1935 1936 1937 1938 1939 1940 1941 Jan. Feb. Mar. Apr. May June 1942

Slight changes in the prices of electric light and power stocks during the past week carried the "Electrical World" index down to 19.4 from 19.8 the previous week; last year, 25.6. Bonds dropped to 104.6; previous week, 104.8; last year, 105.7

District of Col. Check on North American

A formal investigation has been ordered by the District of Columbia Public Utilities Commission into the question of whether control of Potomac Electric Power Co. by North American Co. is legal under district statutes. In many respects the inquiry duplicates evidence in the Securities and Exchange Commission case under the Holding Company Act.

The move was ordered by Commission Chairman Gregory Hankin as an offshoot from Pepco's recent application for authority to sell 30,000 shares of authorized but unissued common stock to Washington Railway & Electric Co. at $100 par each. Arguing that Pepco could get up to $15,000,000 for the stock on the open market, Hankin also directed that the inquiry answer the question of whether the proposed transaction would amount to a "stock dividend," prohibited under district law.

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Ties With Detroit Utility Severed

Directors of the North American Co. last week declared a dividend on the common stock payable April 1 in the form of shares of capital stock of the Detroit Edison Co., in the same manner as the dividends paid in the last three quarters. The payment of this dividend is subject to the approval of the SEC and, if so approved, it will be payable to common stockholders of record March 5 at the rate of one share of Detroit Edison stock on each 50 shares of North American common stock held. No certificates will be issued for fractions of shares of Detroit Edison stock, but, in lieu thereof, cash will be paid at the rate of 36 cents for each one-fiftieth of a share of Detroit Edison stock, based on the current market price of approximately $18 per share.

If this dividend is approved and paid, the North American Co. will have reduced its holdings in the Detroit company to approximately 611,000 shares, or 9.6 percent. Detroit Edison will thus be taken out of the class of subsidiaries of the North American Co. under the provisions of the Public Utility Holding Company Act.

North American Co. explained that the dividend is not a distribution out of its capital or capital surplus and is not a partial liquidating dividend. The dividend is charged on the books of the company to its earned surplus.

FINANCIAL BRIEFS

Proposed offering to the public of 2,695,000 shares of common stock of the Union Electric Co. of Missouri—now owned by the North American Co.—has been delayed because of matters of detail on filings and hearings before the SEC. A nation-wide group of investment bankers had planned to offer the shares this week.

SEC HAS GRANTED the application of the Atlantic City Electric Co. and the American Gas & Electric Co. for approval of the issue by Atlantic City of 62,000 shares of its cumulative preferred stock at a price of not less than $100 and a percentage of 4½, the price and yield to be determined by competitive bidding.

PUBLIC OFFERING was recently made of a new issue of $5,000,000 of Iowa Southern Utilities Co. of Delaware 4½ percent sinking fund debentures, due December 1, 1966. The debentures were priced at 100 and accrued interest.

Rochester Prepared for Emergencies

The Rochester Electrical Industry Emergency Organization, embracing utility companies, electrical wholesalers and distributors, contractors and the local electrical union of Rochester, N. Y., has been formed to mobilize supplies, man-power and transportation if air raids or sabotage threaten to interfere with the city's important war-time production.

Ivar Lundgaard and Sidney Alling represent the Rochester Gas & Electric Corp., which will be responsible for service up to the meter. From this point on the other groups will converge on the plant problem faced by the industrial customers in order to restore service swiftly.

Disruption of electrical service at any key plant will result in the appearance of crews of expert electricians at the plant, wholesalers will open stockrooms as well as maintain delivery trucks and drivers in readiness and contractors and superintendents will rush to the scene of trouble with tools and equipment.

Records of skilled workers are tabulated at I.B.E.W. headquarters according to special skills, sources of supplies are kept up to date at association headquarters and registration lists of trucks, ladders, drills, compressors, welders, pipe dies, etc., have been compiled so that all available resources may be marshaled quickly and dispatched to the jobs when the need arises.

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Fairview Lines to Stay

Portland General Electric Co. has been notified to halt removal of power transmission lines installed for temporary service to the 115-acre LaFollette peach orchard at Fairview, once listed as the site for the $20,000,000 federal aluminum plant. Spokane was chosen finally as the location for the huge war plant. John D. Scott, power sales supervisor for Portland General Electric, said he had been informed to disregard orders to remove the lines, previously issued by United Engineering & Foundry Co., holder of the Fairview construction contract.

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Prepares for Emergencies

An emergency operating unit within the Puget Sound Power & Light Co. has been organized with Roger A. Walker in charge to assist the regular operating department during bombing emergencies. The work is well under way, and when completed between 500 and 600 men and women will be ready for such emergencies.

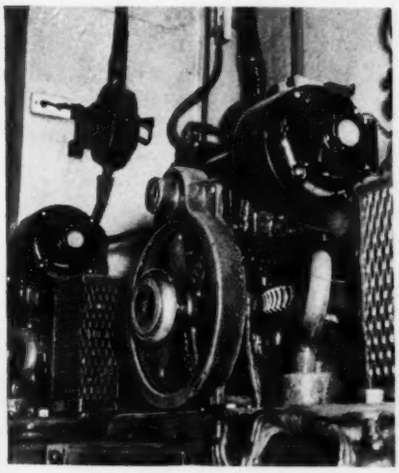
HOW DESIGN . . . CONSTRUCT OPERATE MAINTAIN

Substations

Gear-Motor Cuts Regulator Wear

By E. R. WHITEHEAD
Duquesne Light Company, Pittsburgh, Pa.

Two methods have been used to reduce increased wear in voltage regulator bearings, gears and brake mechanisms caused by excessively high rate of operation, sometimes encountered in following and correcting fluctuating loads. In one, time-delaying the motor-operating relay permits short-time variations to be ignored and only normal "slow" load changes to be recognized.



GEAR-MOTOR reduces voltage regulator wear caused by fluctuating loads

A second method employs a gear motor to reduce greatly the rotor speed. Although each fluctuation affecting the regulating relay energizes the gear motor, the resulting motion of the regulator gears and bearings is so slow that wear is minimized and extremely quiet operation results. Moreover, because of the high ratio of the gear motor, no brake is required, and thus one source of noise and vibration is eliminated. In the installation illustrated a $\frac{1}{6}$-hp. 220-volt, three-phase General Electric gear motor with an output speed of 36 r.p.m. is utilized. The original regulator speed was 900 r.p.m. With this method, life of regulator moving parts is believed infinitely prolonged.

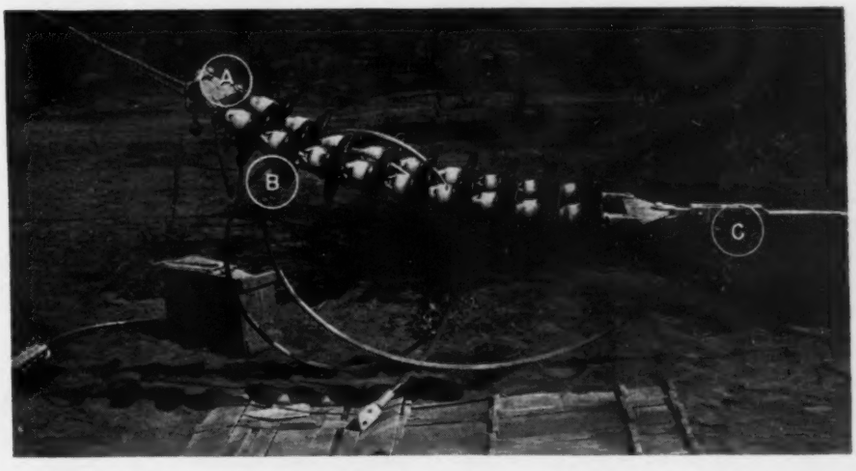
As an indication of the need for remedial measures, regulator operation data may be cited. In one distribution substation near an electric furnace fed at 22 kv., operations increased from a normal of four per hour to a maximum of 271 over a fifteen-minute period. In another distribution station more remote from the furnace, operations increased from a normal of four per hour to a maximum of 380 per hour during periods of furnace operation.

It is emphasized that slow-speed regulator operation does not appreciably reduce the voltage regulation itself, but only minimizes the duty on the regulator.

Tower Lines

Forethought on Ground, Less Work on Tower

Engineers of the Bonneville Power Administration's construction section use ingenuity in keeping as much transmission line construction work as possible on the ground and eliminating all but necessary work on the transmission line towers. The illustration shows how crews connect the conductor to the insulator string and attach one end of the jumper while the whole assembly is on the ground. This method is used instead of dead-ending the conductor to the insulator string on the tower. It promotes safety by eliminating a good deal of tower work and, with an organized crew of top and ground men, contributes to speed in construction. In the illustration (A) shows how a fast detachable clamp is used on the insulator yoke. (B) Jumper is



CABLE, insulators and jumper assembled on ground eliminates high work on towers

temporarily tied to insulator string. (C) Jumper is fastened to conductor on ground. The assembly is raised by a winch line and dead-ended.

Industrial Power

Simple Feed for Multiple-Tool Drive

Wiring material was used economically and flexibly in the new plant of the Jacobs Manufacturing Company, Hartford, Conn., in connection with energy supply to motor and control equipment serving various machine tools, as typified in the accompanying illustration. Here a Kingsbury triple drilling machine for keyhole manufacture in chuck production is fed by a ¾-in. drop lead of vertical conduit bringing three No. 12 conductors to the tool from an overhead supply line and terminating in an Allen-Bradley switch box below the machine table. Rigidity is assured for the drop lead by seating it in a floor flange, and at a tee-fitting connecting with the control equipment a duplex outlet is provided for portable service.

MACHINE UNITS supplied from overhead circuits utilize rigid and flexible conduit

Three ½-hp., 220-volt, three-phase, Holtzer-Cabot motors running at 1,725 r.p.m. drive the drill mechanisms symmetrically on 60-deg. axes and a ½-hp. motor is provided for coolant circulation. Push-button control below the table is accessible to operators, and flexible metallic conduit in short runs from the starting box equipment enables motor adjustments to be readily made as well as absorbing vibration from the drives. In case it is necessary to relocate a machine the drop leads can easily be connected to new outlet points on the overhead circuits, and the expense of providing underfloor feeds with permanent ducts in place there was eliminated. This arrangement of wiring supply was well adapted to the type of material processed, which does not require overhead hoists for handling.

Underground Lines

Put Mechanical Relays on Vault Transformers

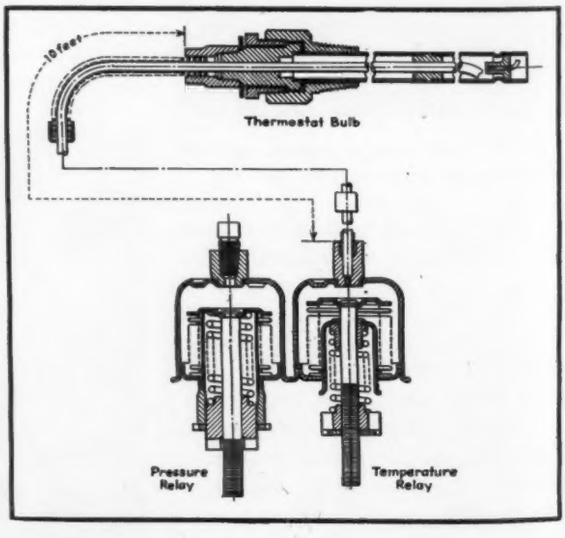
The Detroit Edison Company is using pressure- and temperature-actuated relays of the sylphon bellows type as additional protection on all network transformers of 300-500 kva. The relays act on a primary switch to remove the transformer from service when either operating temperature or pressure becomes excessive due to low-energy faults in the transformer that would not operate the feeder breaker, but which might develop into serious explosions or fires. They also disconnect the transformer in event of abnormal loads which would not open the feeder breaker or blow selective fuses, but which might damage the transformer winding. With the primary switch open, a network master relay trips the network protector on the secondary side of the transformer on exciting current. With the primary switch closed, it trips the protector at definite values of reverse power.

Transformers used on the system are sealed and filled with nitrogen gas over the oil at a definite pressure for a given temperature. To arrive at the setting for the relays, load was placed on the transformer and corresponding pressures and temperatures secured over a wide load range. Pressure and temperature curves were plotted from this data.

Temperature relay is provided with a sensitive bulb element in the transformer thermometer well, to which it is connected by a copper tube. This relay can be set to operate at any temperature in the range from 160 to 190 F. and on the Detroit system is set to trip at 185 F. (85 C.). This setting is somewhat above the top oil temperature after four hours' operation of the transformer at 150 percent rated load, it being desirable to have the setting as low as possible, but still not low enough to disconnect the transformer unless an abnormal temperature develops.

The bellows of the pressure relay is directly connected to the transformer tank above the oil with a copper tube. Pressure relays have an operating range of 6-12 lb.-psi. and are set to trip at 10.5 lb.-psi. gage, which is slightly higher than that for a temperature of 185 F. (about 8 lb.-psi.). The intention is to have the pressure relap trip the primary switch and disconnect the transformer if pressure rises out of proportion to the temperature and above the setting of 10.5 lb.-psi.

An 8-in. copper relief diaphragm that is scored to rupture at an average pressure of 14-lb.-psi. is provided to protect the transformer against damage from any excessive pressure.



PRESSURE and temperature actuated relays for protection of network transformers against low-energy or abnormal loads

New, Improved
PHOTOELECTRIC WATTHOUR-METER TESTER
for easy, low-cost testing

IMPROVEMENTS

1. Entirely new electric circuit—so arranged that the equipment responds to rate of change in light intensity, and is not affected by normal room illumination or any amount of stray light falling on the photocell.
2. No adjustments—grid-bias adjustment eliminated.
3. Two separate revolution selectors—one for light load, the other for full load.
4. Transfer switch—for changing from one revolution selector to the other.
5. Built-in LIGHT-DARK switch—so meters can be tested by shining light through the anticreep holes of the meter disk or by reflecting light from the edge of the disk.

How It Works

THIS automatic equipment for testing watthour meters makes use of the "electric eye." A light beam and relays count the revolutions of the meter under test, and start and stop the rotating standard.

Advantages of Photoelectric Testing

This method of testing provides two fundamental advantages—improved accuracy and saving in time—which reduce the cost of testing.

The timing error is negligible; hence, long runs are unnecessary. This permits a 50-per-cent reduction in running time as compared with the running time of the old hand-switch methods, where the timing accuracy is dependent on the operator's skill.

Additional savings can frequently be made by planning the entire test procedure. How this can be done, how to test meters that do not have anti-creep holes in the disk, how the equipment can be put to many other uses—all this is explained in Bulletin GEA-3348. Ask the nearest G-E office for a copy.

Let this tester save time that is so essential now when experienced operators are going into the services or are being transferred to other jobs. *General Electric, Schenectady, N. Y.*

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

GENERAL ELECTRIC

660-11-5110

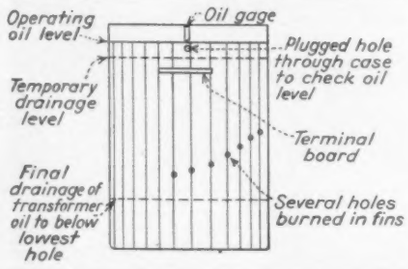
Pole Lines

CO_2 Displacement of Air Aids in Welding

By WILLIAM FITZSTEPHENS
Assistant Superintendent of Distribution
Montana Power Company

Holes occasionally burned in transformer cases have been closed by welding without removing the transformer from the line. The first time this practice was followed by us was in the case of a 23,000/2,300-volt, 250-kva. transformer where it was necessary to maintain uninterrupted service for the customer.

A hot wire, pivotally hung, had swung down across the fins and burned six or eight of them, some clear through. An attempt was made to close the holes with an arc welder without drainage of the case. But oil seeping out of the hole would ignite with explosive force and blow out the arc. So what might be called the "CO_2 method" of welding was tried and worked very satisfactorily.


Operating oil level
Oil gage
Plugged hole through case to check oil level
Temporary drainage level
Terminal board
Final drainage of transformer oil to below lowest hole
Several holes burned in fins

CARBON DIOXIDE put in hole at top of transformer displaces air as oil is drained to various levels for welding burned holes in casing fins

First, the oil was drained to below the plugged hole in the case below the oil gage. Then the plug was removed from the hole and a hose inserted which was connected to the regulator valve of a cylinder of carbon dioxide. The gas was fed in slowly, so that it would not fog. The gas being heavier than air, the latter was expelled. If the transformer is of a type not provided with the small hole in the casing, the handhole in the top may be used.

Having completely displaced the air in the top of the casing down to the temporary, reduced level of the oil, drainage was resumed and gas fed in from above until the level of the oil was below the lowest burn. Then welding could be accomplished without danger of igniting the film of oil that would remain on the interior surface of the casing. The gas would also tend to reduce the severity of a possible flashover on the terminal board due to a current surge that might come during the repair.

After drainage had been effected, it was decided to employ an acetylene torch for welding for several reasons. The metal of the shell is comparatively thin. The torch would heat the metal for a considerable distance around the hole and facilitate the welding. A cleaner weld could also be made than with the electric arc, unless an arc-welding machine of low capacity and fine control were available.

In this first instance we used approximately 7 lb. of gas out of a 50-lb. cylinder. This cylinder was then kept for future jobs of this character.

Work such as this is usually done with the transformer out of service, draining and cleaning the case. But in the experimental example described we could not take it out of service without a very serious interruption and loss to the customer. Having found this method, we are inclined to use it even where the transformer can be taken off, but where there is not ample time to drain and clean by the usual method.

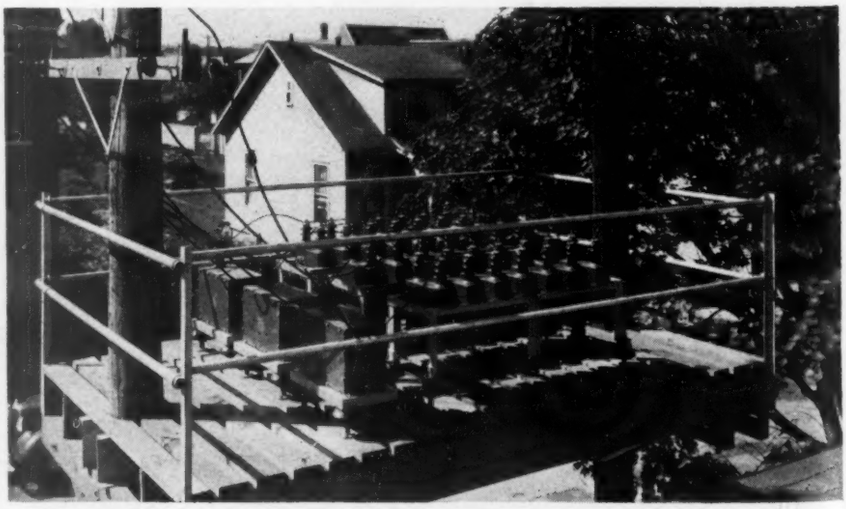
Protection

Protective Device for Series Capacitor

An automatic protective device for a series capacitor has permitted the latter's use in an industrial plant to eliminate voltage fluctuations caused by inductive loads. In the plant of the International Chain & Manufacturing Company, York, Pa., frequent simultaneous operations of several welders caused voltage dips of as much as 20 volts, resulting in weak welds; that is, weak links. Capacitors in series with the power line apply a correction exactly proportional to the inductive load and keep the voltage within about two volts of normal.

The protective device used with the series capacitors consists of an air gap under partial vacuum between two dollar-size brass electrodes, inclosed in solder-sealed porcelain. The partial vacuum causes the current, on gap breakdown, to distribute itself uniformly over the entire surface of electrode without scaring it. The device is small and is mounted with the contactor and high-voltage bushing in a cabinet only slightly larger than a standard capacitor unit.

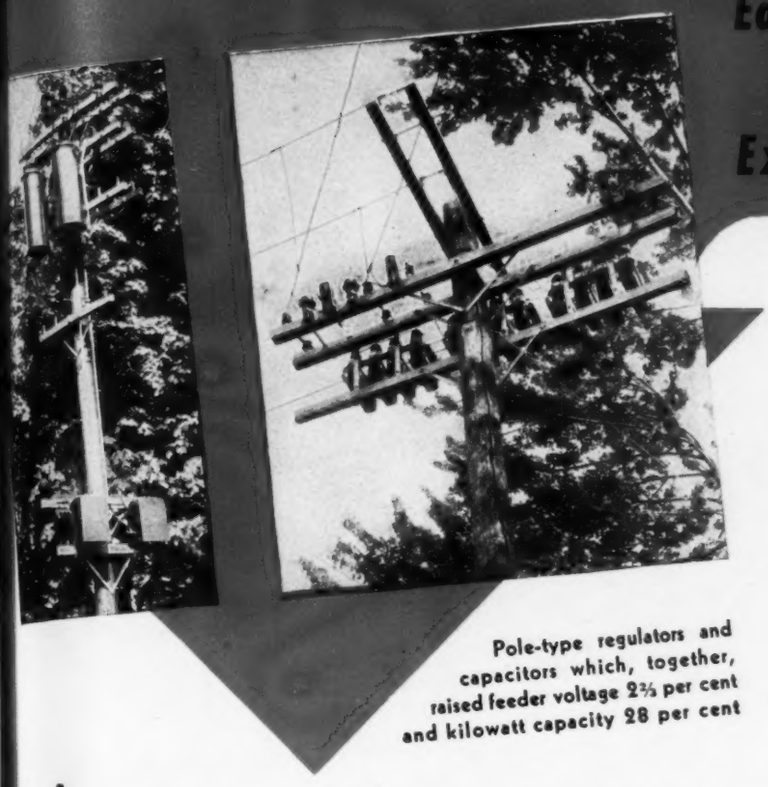
This Westinghouse protective combination removes the capacitor from the circuit during dangerous overcurrents, thereby preventing injury, and returns it to service when the transient has passed, all without attention. An operation counter is connected to the circuit to give a record of the functioning of the device.



AUTOMATIC protective devices, one for each phase, are housed in the three cabinets to the left of the series capacitor units

HOW VOLTAGE REGULATORS AND CAPACITORS INCREASED FEEDER CAPACITY 28%

Eastern Utility Gets Improved Voltage and Forestalls Expenditure for New Feeder



Pole-type regulators and capacitors which, together, raised feeder voltage 2⅔ per cent and kilowatt capacity 28 per cent

AN Eastern utility was recently confronted with a problem which today may be yours. On one of its feeders, greater kw capacity was needed—beyond the midpoint of the feeder the voltage was so low that considerable loss of revenue resulted. Furthermore, at peak load the power factor fell as low as 70%.

How the Problem Was Solved

Additional regulators could not be placed at the substation, as this would have given excessive voltage to customers near it. However, a careful investigation showed that a combination installation of regulators and capacitors would provide an economical and satisfactory solution. Here's what was done:

1. At the end of the line, twelve 15-kva G-E Pyranol* capacitors were installed, resulting in a voltage rise of 2⅔%. It is estimated that, at 85% power factor, carrying capacity was increased from 430 to 550 kw, a 28% gain.

2. Two pole-type G-E induction regulators were installed one-third the way out on the feeder. These now maintain voltage at the proper level for all the customers.

The Savings

1. The released capacity forestalled the purchase of a new feeder and provided for load growth for 5 years, assuming an increase of 5% a year.

2. Revenue return was restored to proper value.

3. Improved power factor cuts power cost at the substation. In the company's purchase-power contract is a penalty clause for power factor below 85%.

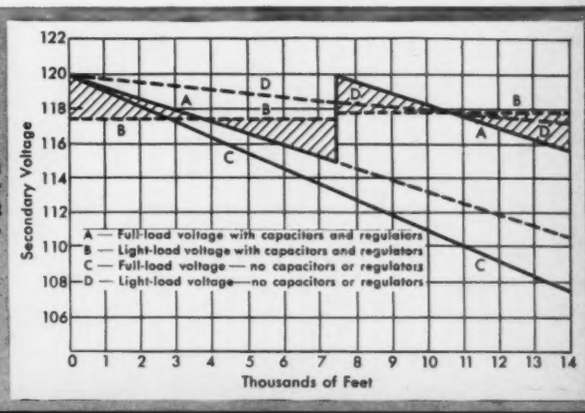
4. Energy losses were reduced by 26,800 kw-hr, based on a circuit load of 525 kva and 85% power factor.

The savings in energy losses†, at the substation purchase price of 1.2 cents per kw-hr, amounts to $322. The value of the revenue recovered—as a result of the higher voltage, at a rate of 3 cents per kw-hr of energy sold, amounts to $1900. These two savings alone, totaling $2222, will pay for the capacitors and regulators in a year and a half.

Profits for You

If your feeders and substations are unable to meet today's increased demands for power because of low power factor and excessive voltage drop, investigate G-E regulators and Pyranol capacitors. They may provide a quick and economical solution. Write today for Bulletins GEA-3333 and GEA-2762. *General Electric Company, Schenectady, N. Y.*

Estimated voltage drop along feeder with and without capacitors and regulators



*Reg. U.S. Pat. Off.

†These savings are realized even though the load has been increased to 525 kva at 85% power factor.

GENERAL ELECTRIC

How to Choose Current Transformers and Meters for Wide Range Loads

Meters

By E. C. WENTZ
Engineering Division of Transformer Division
Westinghouse Electric & Manufacturing Co.
Sharon, Pa.

To meter wide-range industrial or commercial loads the problem is to provide meters and current transformers which will carry the peak load without burning up and yet be sufficiently accurate to register adequately the light load kilowatt-hours.

Most current transformers can carry 150 percent load current for one hour, and even more for shorter periods.

Watt-hour meters can carry up to about 300 percent rated current continuously, although errors tend to increase materially above 250 percent.

Thus, to use each device at its full current capacity, 150 percent of the nominal secondary rating of the transformer should equal, numerically, 300 percent of the nominal current rating of the watt-hour meter.

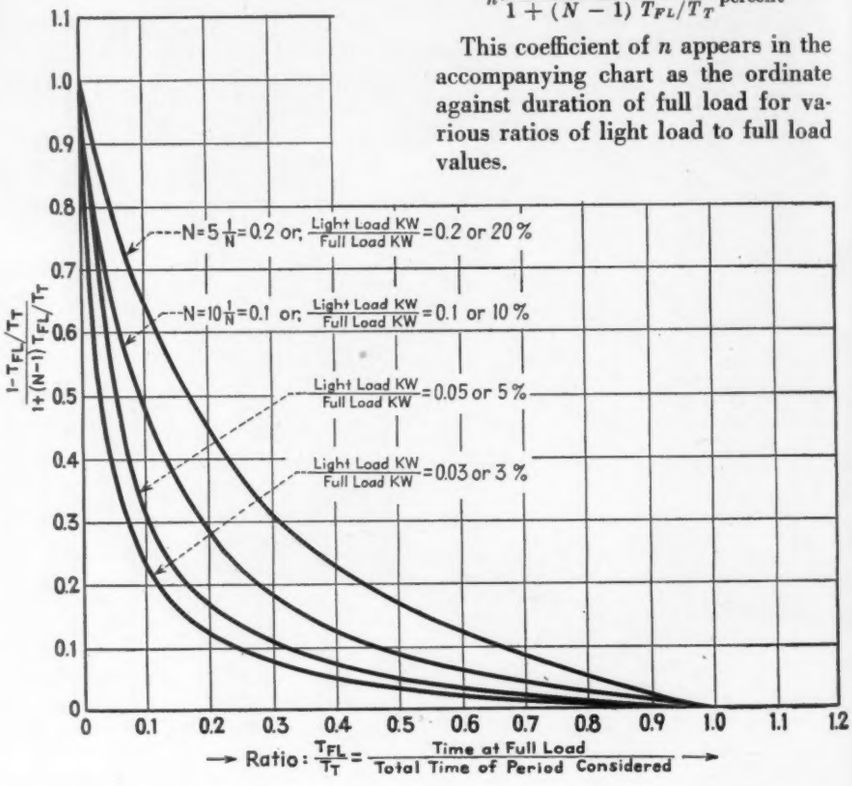
For example, a 5-amp. current transformer (150 percent of $5 = 7\frac{1}{2}$) should logically be used with a $2\frac{1}{2}$-amp. meter (300 percent of $2\frac{1}{2} = 7\frac{1}{2}$).

If the transformer and meter operate at full load for a reasonable part of the time, any error incurred at light load is relatively unimportant; a given percentage error at 10 percent amounts to only half as much error in total registration as the same percentage error at full load where full load exists for only 10 percent of the time.

If the error at light load is n percent, the error in total registration is

$$n\,\frac{(1 - T_{FL}/T_T)}{1 + (N - 1)\,T_{FL}/T_T}\ \text{percent}$$

This coefficient of n appears in the accompanying chart as the ordinate against duration of full load for various ratios of light load to full load values.


1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2
N=5 1/N=0.2 or; Light Load KW / Full Load KW = 0.2 or 20 %
N=10 1/N=0.1 or; Light Load KW / Full Load KW = 0.1 or 10 %
Light Load KW / Full Load KW = 0.05 or 5 %
Light Load KW / Full Load KW = 0.03 or 3 %
(1-TFL/TT) / (1+(N-1)TFL/TT)
Ratio: TFL/TT = Time at Full Load / Total Time of Period Considered

Load	100% Continuously 150% One Hour		150% Continuously (LV Metering)	
Scheme	No. 1	No. 2	No. 3	No. 4
CT Rating	5A Nom.	10A Nom.	5A Nom.	3-1/3A Nom. or 5A Nom.
Sec'd'y Current	5A Cont.	10A Cont.	7.5A Cont.	5A Cont.
WHM Rating	2.5A Nom. 7.5A Cont. 0.25VA 0.04 Ohms	5A Nom. 15A Cont. 0.25VA 0.01 Ohms	2.5A Nom. 7.5A Cont.	1-2/3A Nom. 5A Cont.
	Both of these CT's have the same accuracy at the same VA burden based on rated current.		Both of these CT's have the same accuracy at the same VA burden based on rated current.	
	Preferred: Because lead burden in VA at rated current is obviously 1/4 as great. The CT is adequate for 5A relays.	Not Desirable: Because the CT often will not carry the high burden of 5A relays, and 10A relays are not usually available.	Preferred: The 7.5 amp. CT is available only for LV metering. It will often not be adequate for 5A relays.	Hypothetical: The 1-2/3 amp. watthour meter is not available.
To change scale during light-load season	Change CT ratio or: Change to 1-1/4 amps. WHM (not available)	Change CT ratio or: Change to 2-1/2 amp. WHM. Practical solution if lead burden is kept low. This is the only advantage of scheme No. 2.	Change CT ratio.	

Conclusions

1. The best meter and transformer combination will usually be the $2\frac{1}{2}$-amp. meter with standard 5-amp. secondary current transformer; there may be some justification for either a lower current rating in the watt-hour meter or a higher rating in the transformer.

2. A 10-amp. secondary transformer is not as suitable for use with relays and is, therefore, limited in application.

A "SERVICE TRIP" in 1 second

RECLOSING CUTOUTS RESTORE SERVICE IMMEDIATELY SAVE OUTAGE COSTS—

Even the world's fastest trouble crew couldn't compete with a G-E reclosing fuse cutout for speedy restoration of service. *One second* after a temporary fault blows the first fuse link, this cutout automatically closes the line through a second link and drops a red indicator into view to show it has operated. And it does all this so quickly that motors continue in operation.

Almost as speedy is the job of *installing* G-E reclosing cutouts, if you're already using G-E indicating cutouts. Just replace the single-element doors with reclosing doors (a one-minute job using the new G-E jumper stick). Usually this has no effect on your co-ordination set-up.

Give G-E reclosing cutouts a trial on some of your important lines or hard-to-reach locations. You'll find they're the money-saving way to give your customers better service—in fact, *they can pay for themselves the first time they operate!* Ask your G-E representative to show you a sample—or write for Bulletin GEA-3448. General Electric, Schenectady, N. Y.

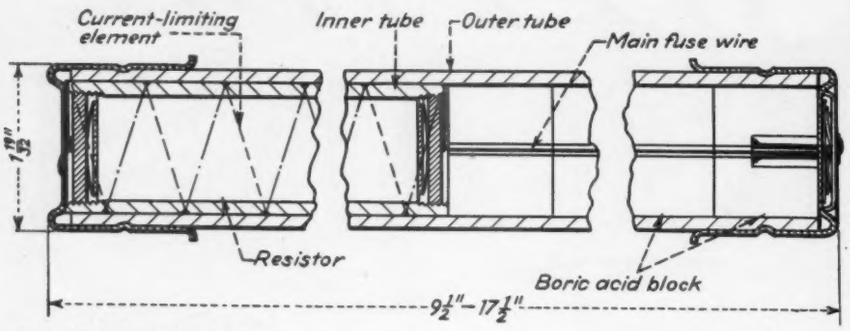
FORMULA FOR CUTOUT FLEXIBILITY

The G-E reclosing door is one of five standard items in the G-E Formula for Cutout Flexibility. Two others are the single-element door and the disconnect door All three doors fit the housings of both the 50-amp, 5-kv cutout and the 50-amp, 7.5-kv cutout Here's maximum flexibility, interchangeability, standardization. Here are two housings and three doors—*five items in all*—to fill 80 per cent of all distribution fuse cutout requirements.

A similar 2-housing, 3-door combination in the 100-amp rating is available for the other 20 per cent.

GENERAL ELECTRIC

406-8-5254



OUTLINE of boric-acid fuse

Protection

Boric-Acid Fuse Limits Fault Current

A boric-acid "Deion" fuse, combining the function of a fuse and a current-limiting resistor, has been developed to provide protection for potential transformers and the respective systems to which the transformers are connected.

The fuse is designed to clear a faulty transformer from the line within one-half cycle. It does not blow on magnetizing inrush currents. But it does blow rapidly enough to prevent a transformer with a short-circuited secondary or partial winding fault from producing an excessive amount of conducting and flammable gases.

The fuse consists of a main fuse element and a current-limiting element. The main fuse element is surrounded by solid boric acid and this is where final circuit interruption occurs. Current-limiting element is a silver wire wound spirally on a fiber tube. This element limits the current input to the fault and thus reduces the violence of the fault and keeps it from spreading to adjacent equipment.

In addition, this fuse counteracts the voltage surges caused by the magnetic energy released from the bus when the fault current is interrupted. The voltage-limiting element is a silicon-carbide rod in parallel with the current-limiting element. The current by-passed through this resistor rod is sufficient to limit the maximum voltage surge on current limitation to a value scarcely greater than the normal system voltage.

The fuse is noiseless and smokeless in operation. It has a continuous rating of 0.5 amp. at voltages ranging from 2,300 to 23,000. All the elements are contained in an outer fiber tube.

Line Engineering

Sleet-Wind Values From Beaufort Scale

By E. A. ZEHFUSS
Duquesne Light Company, Pittsburgh, Pa.

Values of wind velocity are noted and recorded by member-company observers in the continuing program of the Pennsylvania Electric Association for studying wind and ice loading on conductors. The observers use the Beaufort scale of wind in deciding, without instruments, what to put down as the prevailing velocity. This scale, omitting the "mode of estimating aboard sailing vessels" is reprinted, by permission, from "Wind Stresses in Buildings," a book by Robins Fleming, published by John Wiley & Sons, Inc., New York, 1930.

Velocity Equivalent of So-Called Beaufort Scale of Wind

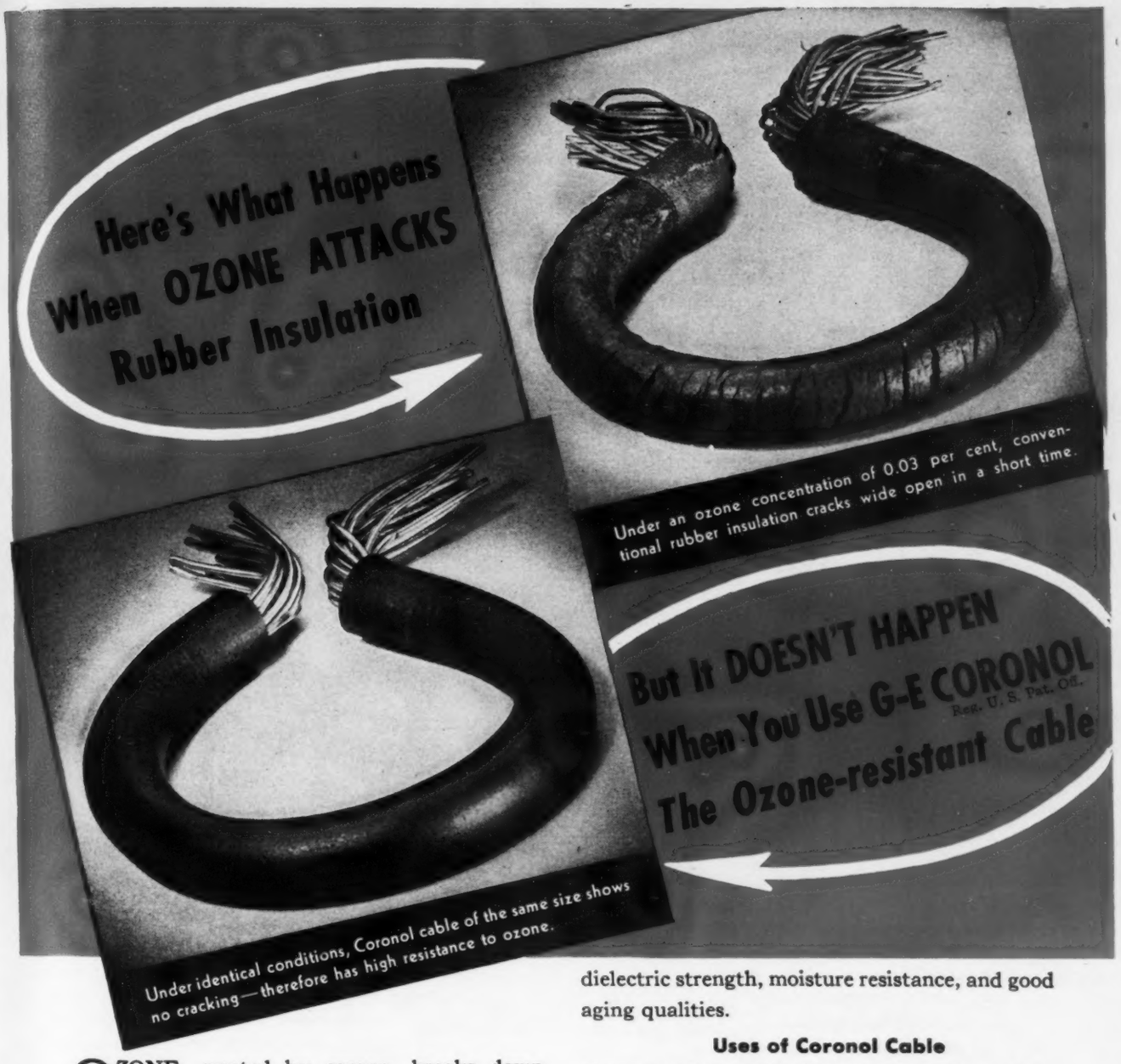
Beaufort Number	Explanatory Titles	Specification for Use on Land	Meters per Second	Miles per Hour
0	Calm	Calm, smoke rises vertically	Less than 0.3	Less than 1
1	Light air	Direction of wind shown by smoke drift, but not by wind vanes	0.3–1.5	1–3
2	Slight breeze	Wind felt on face; leaves rustle; ordinary vane moved by wind	1.6–3.3	4–7
3	Gentle breeze	Leaves and small twigs in constant motion; wind extends light flag	3.4–5.4	8–12
4	Moderate breeze	Raises dust and loose paper; small branches are moved	5.5–7.9	13–18
5	Fresh breeze	Small trees in leaf begin to sway; crested wavelets form on inland waters	8.0–10.7	19–24
6	Strong breeze	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty	10.8–13.8	25–31
7	High wind	Whole trees in motion; inconvenience felt when walking against wind	13.9–17.1	32–38
8	Gale	Breaks twigs off trees; generally impedes progress	17.2–20.7	39–46
9	Strong gale	Slight structural damage occurs (chimney pots and slate removed)	20.8–24.4	47–54
10	Whole gale	Seldom experienced inland; trees uprooted; considerable structural damage occurs	24.5–28.4	55–63
11	Storm	Very rarely experienced, accompanied by widespread damage	28.5–33.5	64–75
12	Hurricane	.....	33.6 or above	Above 75

Industrial Power

Improved Drive for Wire Reeling Machine

By A. F. METZGER
Engineering Department,
General Electric Company, Boston, Mass.

In order to keep the heat treatment uniform in passing wire through tempering and patenting furnaces it is necessary to draw the wire through the furnaces at a steady rate. In conjunction with General Electric, Sleeper & Hartley of Worcester, Mass., have designed a reeling machine containing improvements over previous equipment, and which will heat-treat and reel sixteen strands of wire simultaneously, holding the degree of heat treatment within very close limits. Now all reels can be


Here's What Happens When OZONE ATTACKS Rubber Insulation
Under an ozone concentration of 0.03 per cent, conventional rubber insulation cracks wide open in a short time.
But It DOESN'T HAPPEN When You Use G-E CORONOL
Reg. U. S. Pat. Off.
The Ozone-resistant Cable
Under identical conditions, Coronol cable of the same size shows no cracking—therefore has high resistance to ozone.

OZONE, created by corona, breaks down ordinary rubber compounds. If such compounds were made up for ozone resistance alone, they might well be lacking in the other good qualities that are necessary. Achieving ozone resistance at no sacrifice of strength in other qualities is one of General Electric's accomplishments in the art and science of compounding.

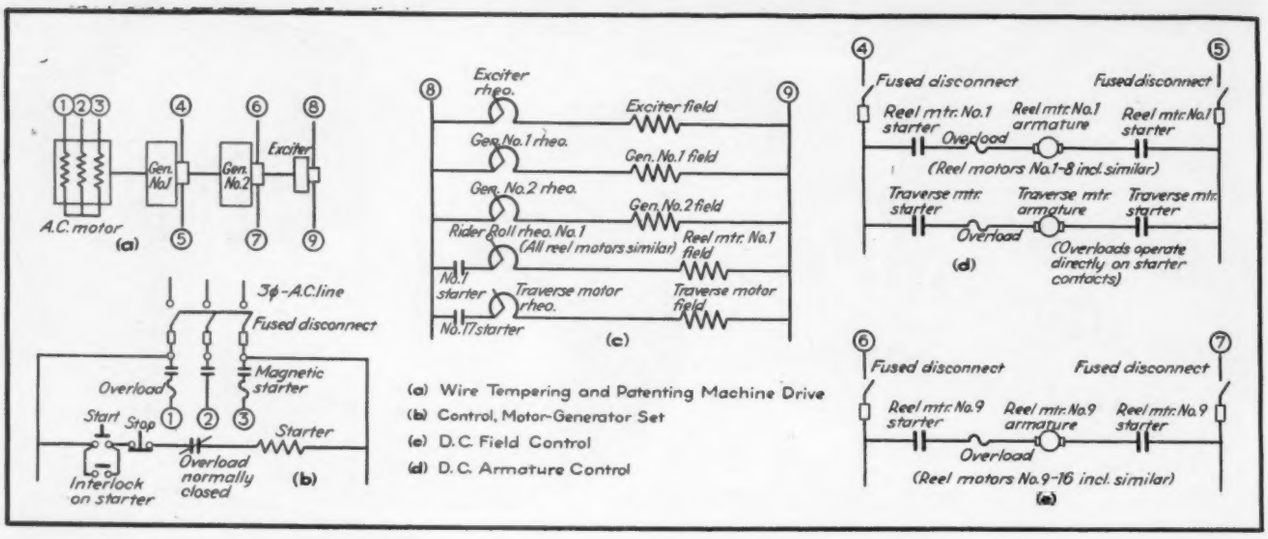
Coronol is an oil-base compound developed by General Electric to provide ozone resistance in *combination* with other good properties such as dielectric strength, moisture resistance, and good aging qualities.

Uses of Coronol Cable

Coronol cable applies in general to the voltage range for rubber-insulated cable. Use it for station, generator, and station auxiliary leads, aerial cable, and nonleaded underground cable. For information on Coronol or any other power and control cables, consult the nearest G-E office, or write General Electric, Schenectady, New York.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

GENERAL ELECTRIC



SCHEMATIC wiring diagram of motor drive and control layout

started and stopped at any time; a steady, light tension is maintained, and besides obtaining more constant speed, there is no danger of stretch.

The machine consists essentially of a rack on which are mounted sixteen G.E. totally inclosed gear motors (½ hp., 21.9/43.8 r.p.m., 230-volt), eight on a side, with a demountable reel located directly on each gear-motor shaft. A traversing mechanism driven by another G.E. totally inclosed gear motor (¼ hp., 4.3/13 r.p.m., 230-volt) feeds the wire back and forth over the face of the reel as the wire builds up.

The eight motors at one end of the reeling machine are fed from one generator, while the eight at the opposite end are fed from another. This makes it possible to run two different sizes of wire at different speeds on either end of the machine at the same time.

Because the wire is wound on a reel directly on the motor shaft, it is necessary that the reeling motors start off at a comparatively high speed and slow down in proportion to the increase in the diameter of the reel. This speed characteristic is obtained by using a rheostat with a very large number of buttons operated by a rider roll which continuously measures the diameter of the reel and changes the rheostat accordingly.

The process requires that the wire speed be adjustable to accommodate different sizes of wire. This is obtained by driving the motors from the generator of a motor-generator set and adjusting the generator voltage. An exciter on this set supplies both generator and motor fields. Variations in wire speed are obtained by adjusting the armature voltage of the reel motor.

The traversing mechanism is operated by a motor which is also connected to the adjustable voltage supply feeding the reel motors, so that the speed of the traversing device will always be proportional to the speed of the wire. It is possible to adjust the speed of the traverse to take care of different widths of wire by a manually operated field rheostat. While such an outfit costs about three times as much as machines previously used for the same purpose, it has been found that where quality is a factor, the new drive is more economical.

Pole Lines

Douglas Fir Poles Used on TVA Line

For a 50-mile section of the Norris Dam-Pineville 154-kv. transmission line Tennessee Valley Authority used pressure-treated creosoted Douglas fir poles to support the three conductors. This section of the line, which traverses mountainous country in eastern Tennessee, is supported by H-frame structures, usually nine per mile. At angle points three-pole structures are used.

Douglas fir poles used for the structures range in length from 65 to 90 ft., are Class 1 and conform to American Standards Association specifications. In addition, span lengths varied. By varying both pole and span lengths desired clearance was obtained for the terrain traversed.

Crossarms are tapered spar arms. They are 35 ft. long and machine shaved for desired surface finish. Suspended from these crossarms are insulator strings (generally eleven units) which carry the three conductors of 700,000-cir.mil copper.

Steam Plant

Protective Coatings in Steam Plants

By A. K. INGRAHAM
Assistant Engineer Pacific Gas & Electric Company, San Francisco

Adequate protective coatings for pipes, water boxes, pumps, tanks and concrete sumps around steam plants are something that give the maintenance engineer many headaches. Considerable experience has been had on the Pacific Gas & Electric Company system with a variety of coatings selected to prevent corrosion or for some other specific protective purpose. However, the search for better materials continues.

One of the earliest materials used was *bitumastic paint.* Some of these were brushed on at high temperature, but the resulting fumes were so obnoxious to personnel that this was discontinued. However, coatings with a *petroleum base* have continued in use with fair results.

One experiment was conducted with a carefully brushed *base paint* followed by a *rubber coating.* This was applied to cast-iron pipe, steel

s Everything Claimed for It!"*

Lighting Levels and Low Surface Brightness!

THE MOST SIGNIFICANT MAJOR DEVELOPMENT IN THE ANNALS OF FLUORESCENT LIGHTING!

FIRST BETTER LIGHT, BETTER SIGHT FLUORESCENT COMMERCIAL FIXTURE!

e after wave of acclaim—that's the acceptance for the URC Research Luminaire—the fixture that practices you, the Utility Lighting Companies of America, been preaching for years!

re's the fixture that contributes mightily to the health, ort and convenience of the customers you've been ally serving. Here's high lighting intensity with such urface brightness that "65 ft. candles on the working seems very deceiving until an actual reading is made" etter on opposite page).

re's the fixture that's adaptable three ways—individual g, individual pendant, and continuous row. Here's nlined beauty, unique simplicity of installation, easiest enance.

e utterly NEW URC 4-light, 200-watt Research Lumi- gives you an opportunity to build load on a sound, essive basis, to replace troublesome, inefficient, in- adequate lighting vehicles now on your lines. It offers your public higher standards of Better Light, Better Sight than it has known before, at no greater comparable cost.

We've prepared a complete program of cooperation for the Utility Lighting Companies of America. Ask for the URC Brochure giving complete technical data, for effective promotional materials—descriptive folders, envelope stuffers, newspaper ad mats, etc. Just write:

MITCHELL MANUFACTURING COMPANY
2525 Clybourn Avenue, CHICAGO

TCHELL *Manufactures* IT!

pipe and a concrete sump, all of which were subjected to sea water. Some initial success was followed later by almost complete deterioration due to blistering and separation. *Lead spray* has been applied successfully to cast-iron water boxes. This metal spray process requires care in application if pinholes are to be prevented. The vapor is lethal and adequate ventilation is essential, such as the air cone ejector used by welders.

Following the practice of water companies and industrial plants handling certain corrosive liquids, the company has used *cement-lined pipe* for carrying sea water. Pre-fabricated pipe from ½ in. to 12 in. was used. In most recent steam plants all buried piping was of this type.

The water treating system at one of the company's new steam plants produced a novel type of corrosion—apparently the result of free oxygen released in the water by successive temperature rises in the heaters. *Cement-lined pipe* resisted the corrosion and all other affected piping has been replaced. However, it is recognized that in time the silica may dissolve due to the high temperatures. The cast-iron heads of the heaters also suffered from corrosion and these were *sprayed with lead.*

In the chemical treating plant at these steam plants three types of linings are used, *vulcanized rubber, lead and glass.* Much of the piping lined with rubber was processed locally. The process is simple, consisting merely of the application of a ⅛-in. interior coating of a rubber mixture placed by hand or with a mandrel. This is then vulcanized at 60 lb. steam pressure. The rubber is brought out over the flange to make a complete seal.

At the new oil refinery plants one of the fuels used is acid sludge, which is fairly rich in sulphuric acid and is highly corrosive at temperatures of 190 to 200 deg. Tanks for the storage of this sludge are *lined with lead* and sumps and drains are constructed of *acid-resisting brick and tile. Heavy red brass piping* is used for the most part and acid-resisting *valves of nickel-chrome-molybdenum-steel alloy* have been installed. A few *glass-lined valves* also are functioning successfully.

The steel stacks at these plants have an *asbestos-asphalt lining* for protection against the acid stack gases resulting from the combustion of this acid sludge. However, this lining must be protected against heat and such protection is provided by a 4-in. lining of "gunite."

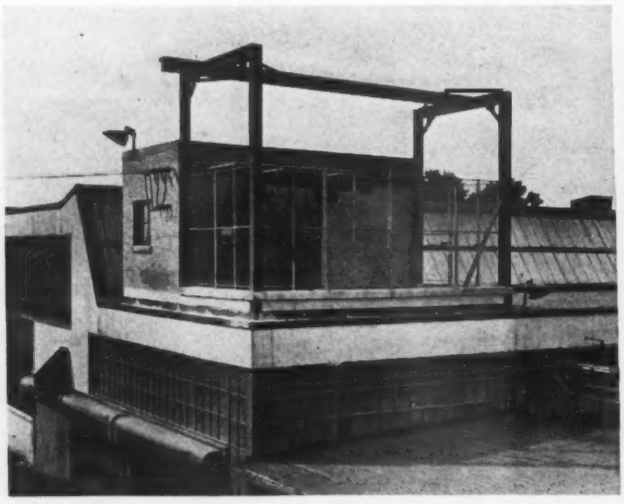
Industrial Power

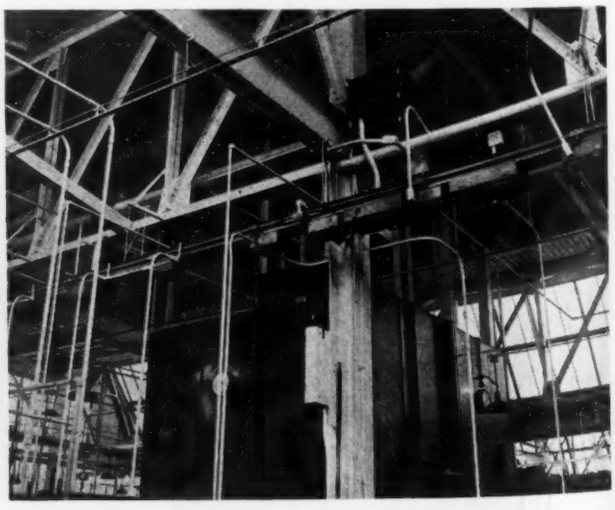
Flexible Supply of Industrial Energy

In a newly erected Eastern industrial plant closely allied with defense material production purchased energy is delivered to a roof type substation, freeing manufacturing space below from much electrical auxiliary equipment and allowing for rapid expansion along lines symmetrical with the initial layout. Protection against interference with electric service is also provided. The substation occupies a space only 22 ft. square x 13 ft. 3 in. high, and at present contains two 333-kva. transformers located outdoors on a concrete mat in front of a bricked-in compartment 21 ft. 4 in. long x 10 ft. wide inside, and divided into primary and secondary rooms separated by a 4-in. brick barrier and swinging door for fire protection. Insulators are carried on 2-in. galvanized pipe framing, making up an arbor for bus runs.

Incoming energy at 4,800 volts is controlled by a primary circuit breaker from which connections are made to the transformers, which are tied to the secondary buses by two 600,000-cir.mil cables per phase. By Scott connection, three-phase, 240-volt energy is obtained for factory use, and the plant power supply from this bus is controlled by a 2,000-amp. air circuit breaker ahead of a 2,000-amp. busway leading into the manufacturing and office sections. Branch circuits for power and taps for lighting transformers located above the manufacturing level are taken off sections of Trumbull busbar duct at convenient points. Switch boxes are equipped with prongs and can be adjusted to vary power supply locations every 6 in.

Straps from transformer cases and other equipment are carried to a No. 4/0 stranded copper cable and thence to a ground mat about 6 ft. square, with corner ground rods of copper 1 in. in diameter x 10 ft. long. The outside of the transformer inclosure is screened with wire netting, a removable section being provided at one end to facilitate handling equipment by trolley hoist, hand-operated, carried on an I-beam.





ROOF-MOUNTED transformers are screened and segregated from manufacturing departments (left). Busway construction provides maximum convenience in arranging energy for lighting transformers and power circuits (right)

All Out CIRCUIT PROTECTION

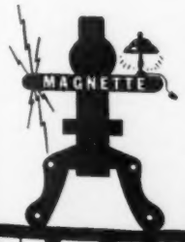
HEINEMANN

"MAGNETTE" SERVICE CENTERS

***Equipped with* HEINEMANN *Fully Electro-Magnetic* CIRCUIT BREAKERS**

Made in units to accommodate up to 6 branch circuits, these service centers fill every need for circuit protection in residential and apartment house wiring. The circuit breakers are constructed so as to allow passage of inrush current but trip instantly on short circuits and dangerous overloads.

"MAGNETTE" Service Centers are made for flush or surface mounting. If installed for 2 or 4 circuits the capacity can be increased by adding the proper breakers. Convenient knockouts are placed in the covers and bases for this purpose. Terminals are provided in the upper end for service wires running from the meter.



Adequate Stocks are available for Prompt Delivery
Send for Literature

HEINEMANN ELECTRIC CO.

103 PLUM STREET *Established 1888* **TRENTON, N. J.**

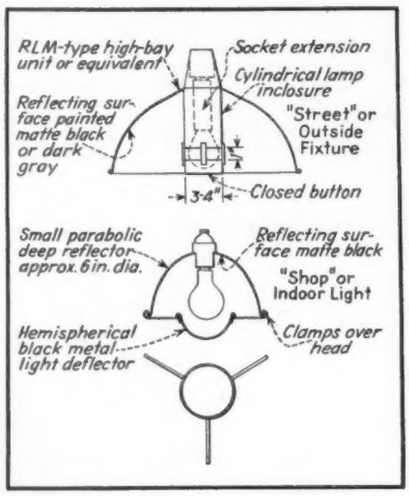
IDEAS for BLACKOUTS

Indoor, Outdoor Blackout Fixtures

Accompanying illustrations show essential elements of two improvised blackout lighting fixtures displayed by the Chicago Lighting Institute recently. These units represent possible methods of making blackout fixtures from regular lighting equipment with a minimum of alteration.

For outdoor use in street, alley, yard, or other places where dimmed lights may be used to mark obstructions or permit essential work to be done, an RLM type high-bay could be used. To make it a blackout fixture the reflecting surface and outside should be painted a matte black or dark gray to reduce reflecting efficiency and eliminate sheen from the outside enamel surface. A socket assembly should be used which will bring the small bulb used near to the rim of the fixture. Socket and lamp are covered with a cylindrical metal lamp inclosure with horizontal slit about ¾ to 1 in. deep near the bottom. The placing of this slit should be such as to prevent escape of light above a plane inclined downward 10 deg. from horizontal. Size of the lamp used differs with application and may range anywhere from 25 to 60 watts.

BLACKOUT lighting fixtures improvised from standard units


RLM-type high-bay unit or equivalent
Socket extension
Cylindrical lamp inclosure
Reflecting surface painted matte black or dark gray
"Street" or Outside Fixture
3-4"
Closed button
Small parabolic deep reflector approx. 6 in. dia.
Reflecting surface matte black
"Shop" or Indoor Light
Hemispherical black metal light deflector
Clamps over head

ASSEMBLY details of blackout fixtures

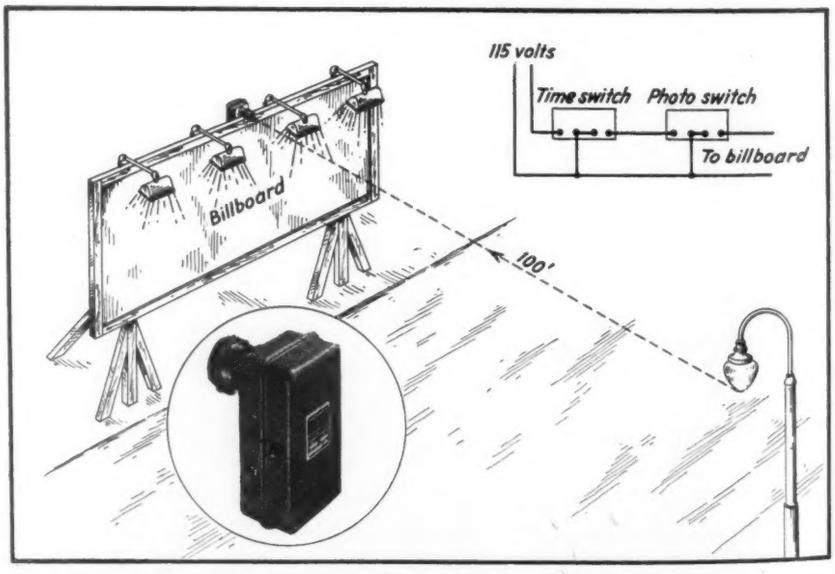
A "shop" or indoor blackout fixture suitable for essential machines, etc., can be made from any small parabolic type deep reflector by painting the reflecting and outer surface of the unit matte black or gray and adding a hemispherical light deflector at the bottom of the unit as shown. The cup-like deflector may be attached to the bead of the reflector with spring clips or other convenient fastening. Like the reflector to which it is attached, the deflector should be painted black.

Blackout Control by Photocell Relay

Immediate extinguishment of illuminated signs, billboard lighting and other outdoor displays visible after dark has become a vital necessity in case of air raid alarm. In many localities such lighting has been ordered to be cut out unless provision has been made for very rapid control of these installations, and facilities to insure this control have been receiving intensive study by safety committees, power companies, air raid wardens and others.

At Cambridge, Mass., Photoswitch, Inc., has met this problem by developing an electronic control relay designed to function upon the shutting off and switching in of an adjacent street light, thus providing an instantaneous means of blacking out one or more electric signs, etc., in a given area upon occurrence of the emergency. Since street lights are cut off at a public utility plant or substation (or in the field) on receipt of an air raid alarm, their operation in connection with this equipment provides a first-class source of control of display lighting and eliminates the human element in governing the functioning of such installations.

The control consists essentially of



PHOTOCELL relay controlling billboard illumination is actuated by rays from adjacent street light (left). Photoswitch control box with lens at upper left to collect rays from street light 100 ft. distant (right)

a photocell and associated relay unit which is tied into the time switch or main circuit of the illuminated device on the ordinary a.c. or d.c. 115-volt supply. A time delay of about one second has been incorporated in the control circuit to prevent flickering in case of temporary flashing of the street light, a momentary cessation of light in the vicinity, or other sudden fluctuation. The lens is equipped with a long hood to shield it from other sources of direct light apart from the controlling point, and provision has been made for adjusting the photocell position in the field to obtain maximum performance in relation to the governing source.

Standard vacuum amplifying tubes are used for relay operation, their life expectancy being at least 2,000 hours, and the photocell tube, specially developed for this use, has an expected life of from two to five years. The capacity of the a.c. relay used is 20 amp., and a 10-amp. relay is used in d.c. installations. Tests by the Pacific Gas & Electric Company indicate that the outfit will operate on as low an intensity as 0.05 ft.-candle. The relay is of the double-break type and will readily handle 2,000 watts. An important point in the application of such equipment is that it enables the sign user to maintain his display service up to the moment of the street-lighting blackout, followed by instant restoration of the display upon the return of street lighting following the all-clear signal.

This equipment has been approved by the Boston blackout control officer and city inspection department for field use. An initial installation in Boston has been made to control six billboards at Riverway and Brookline Avenue. The Photoswitch company has also developed controls of this type for use at 20 and 10 ft. from the governing sources.

•

Fluorescent Printing for Blackout Use

Blackout hand lamps (flashlights) for reading fluorescent-treated maps, charts, etc., have been recently developed and are available without preference rating (one to a customer) by those engaged in official defense planning and operation. They hold back 99 percent of visible light, passing a very small amount of the blue, so that when aimed directly at the dark-adapted eyes of an observer in absolute darkness it cannot be detected at a distance of 250 ft., but can be located by most eyes at 150 ft. It will pick up a fluorescent marker 30 to 40 ft. away. Average life of the lamp, if burned continuously to failure of lamps, 30–40 hours; batteries, 100 to 125 minutes.

With moisture in the air direct rays of the sun are most dangerous to the vast majority of fluorescent materials. Many of the most common substances are affected by a few minutes exposure to summer sunshine, and are therefore designed for *indoor use only*. If protected from direct sunlight and strong daylight in covered books, etc., they will retain their fluorescent properties without change for years.

Industrial Power

Constant Voltage for Ore Bridge Control

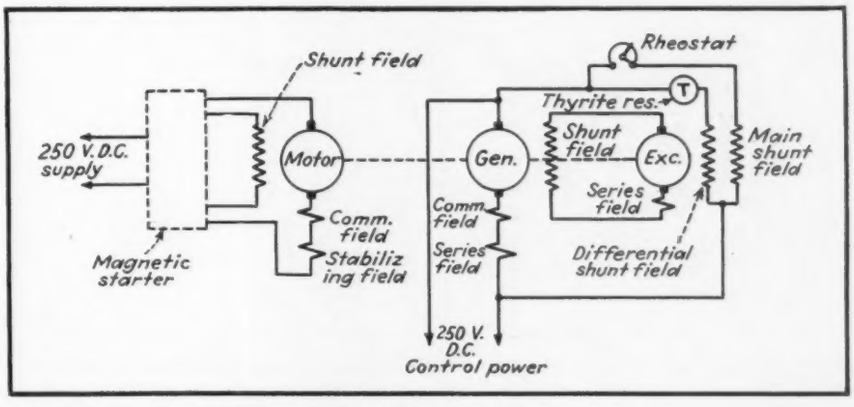
By W. M. BALLENGER
General Electric Company, Chicago

Inland Steel Company, Indiana Harbor, Ind., has seven ore bridges, all on one runway and operating from the 250-volt d.c. mill supply. The closing and holding line motors on each ore bridge are rated 275 hp., 60 minute, 75 deg. C., compound wound. When several bridges are working out near one end of the dock load requirements are so heavy that the potential may occasionally dip to 150 volts. This is no handicap to the main motors as their torque characteristics at digging speeds are unaffected, but at this low voltage contactors and shunt brakes become sluggish and may even fail to pick up, thus slowing down operations.

It was not practical to improve voltage regulation by increasing the amount of copper; therefore, other ways of economically relieving the condition were studied. As the best answer to the problem, a thyrite-controlled exciter-generator set was recommended for each ore bridge, the function of the set being to furnish 5 kw. of control power at a constant potential of 250 volts even though the supply voltage dips to 150 volts.

Each set consists of a 10-hp., 1,750-r.p.m., 230-volt d.c. shunt-stabilized motor driving a 5-kw., 250-volt, d.c. compound-wound, separately excited generator and a small exciter having special fields. The set is rated 40 deg. C. continuous and is designed for 100 percent momentary overloads.

Referring to the sketch: The motor is not fully saturated at rated voltage; therefore, the speed of the set does not decrease in direct proportion to the decrease in supply voltage. The shunt field of the generator is wound for a low voltage. The exciter has a differential shunt field, a main shunt field and a cumulative series field, all connected as shown. In the circuit of the differential shunt field is a thyrite resistor, the ohmic resistance of which varies inversely as a definite power of the applied voltage. The rheostat in the main shunt field is used to adjust for the desired generator voltage. Thus, the characteristics of thyrite, in combination with the suitably proportioned fields, causes the exciter to act as an inherent voltage-



MAINTAINS control voltage at end of long d.c. feed

regulating medium for the generator, to maintain a constant 250-volt output even though load on the generator varies widely and the supply voltage dips to 150 volts.

As a first step, two ore bridges were equipped with sets. Results obtained were highly satisfactory and the remaining five bridges were then equipped. An additional set was obtained as a spare. The operators have expressed complete satisfaction with the improved operation of their bridges, especially when working in close quarters, such as when unloading a boat where accuracy of control is important.

Laboratory

Oil Power-Factor Measured by Bridge

By E. J. MOMMO

Public Service Electric & Gas Company, Irvington, N. J.

Power-factor measurements — capacitance and leakage components — of insulating oils in service in 132-kv., three-phase, three single-conductor cables are being carried on at Public Service Electric & Gas Company's testing laboratory with a high-voltage Schering bridge designed especially for the utility by General Radio Company.

Main parts of bridge, which is conveniently assembled on two relay racks, are two ratio arms and a standard zero-loss condenser. Scale readings of this guarded conical type condenser are referred to a calibration chart and transferred to micro-micro-farads. By shielding and by using low-loss insulation materials for the condenser bridge losses can be considered as nil.

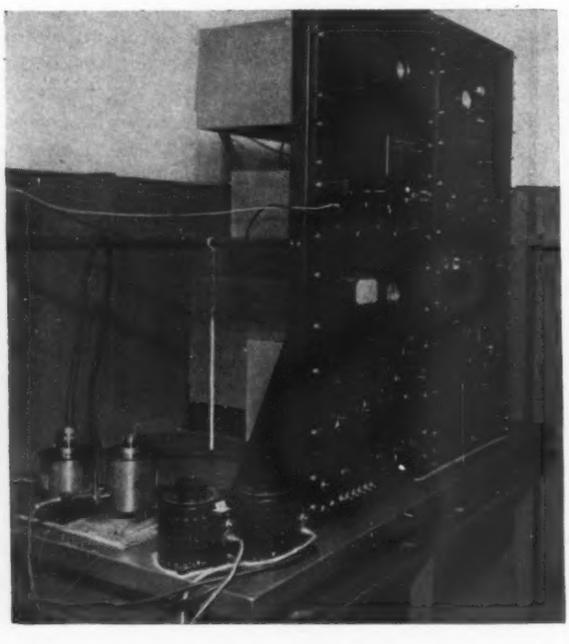
Electrical balance of bridge circuit and its guard circuit is detected by a cathode-ray null detector. A three-stage amplifier with about 67 db. gain regulates sensitivity. Shielding of bridge circuit, including amplifier, which are at same potential, is used as capacitance of guard circuit.

Guard circuit elements permit reasonable adjustment of magnitude and phase angle of guard circuit and thus complete balancing. While guard adjustments are being made, detector and its amplifier are switched to that circuit, to detect point of balance between it and corresponding section of measuring circuit.

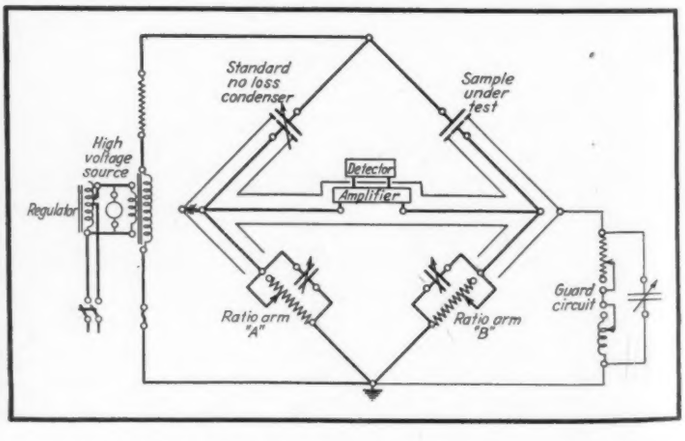
Current supply for bridge is usually taken from 60-cycle source. Variac-controlled transformer supplies any voltage to 2,000 volts, and this circuit is protected by fractional-ampere fuses and 0.1-megohm current-limiting resistor.

Thermocouple instrument panel for temperature measurements of oil samples has switching facilities for six thermocouples and is part of bridge assembly. Nickel oil test cells are of type designed by W. F. Davidson of Consolidated Edison Company of New York. Each cell has its own Chromalox 250-watt, 115-volt ring-type heater, Variac-controlled, which heats air surrounding test cup or cell. Leads interconnecting various bridge sections and oil cups are shielded and connected to guard circuit.

After oil sample—which has been most carefully removed from cable, bottled and stored—has been poured into a thoroughly cleaned test cup, heater in cup bottom is turned on. Tests are made at oil temperatures of 40 to 110 deg. C. If values are nearly the same, tests of two or three specimens are considered sufficient.

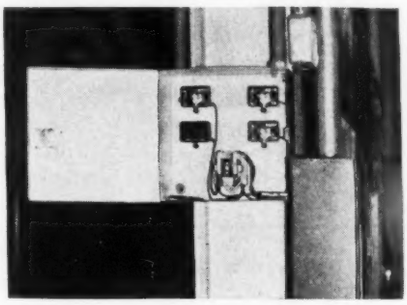


POWER-FACTOR determination of cable insulating oils made with modified form of high-voltage Schering bridge, conveniently assembled on relay racks



Protection

Protect Small Motors at Low Cost



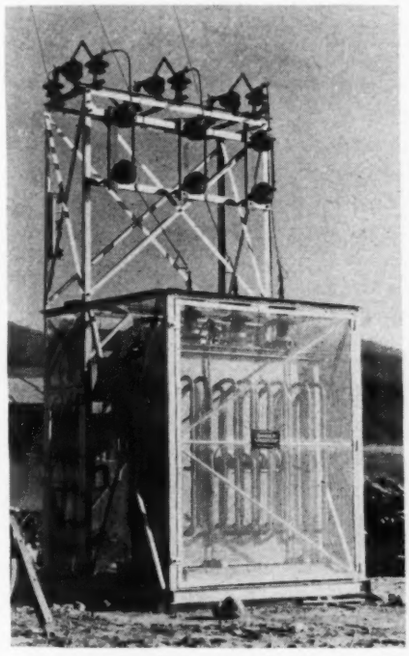
To avoid the necessity of buying 1-hp. size starters for the many fractional-horsepower polyphase motors in unit heaters at the new McCullock Engineering Corporation plant in Milwaukee, inexpensive single-pole sentinel breakers have been introduced in each "hot leg" of the motor circuit on the heater side of the thermostat relay. In the event of a fault one of the breakers will trip, single-phasing the motor and causing it to draw enough current to trip the second sentinel breaker and isolate the motor circuit.

Substations

Semi-Portable Sub Delivers Economies

By FRANCIS CURTIS
California Electric Power Company, Riverside

A semi-portable substation which fills the need for delivering service of a temporary nature and from which savings are obtained in the form of high salvage value and reduced erection cost has been developed by the California Electric Power Company. In designing the station, consideration was given to making it completely portable by mounting directly on a suitable trailer. However, this was abandoned due to the excessive increase in investment. Subsequently experience has proved that loading and unloading from a freight truck was not a serious disadvantage as compared with a trailer-mounted substation.



HIGH salvage value and low erection cost are two advantages of this semi-portable 300-kva. substation

The substation equipment consists of a galvanized fabricated structure 8 ft. square by 10 ft. high inclosed by a small-mesh wire screen. Inside is a three-phase, 300-kva., 33,000/2,300-460-volt transformer, an automatic low-tension oil circuit breaker and metering equipment. Breaker and meter are on the secondary side. A superstructure 3 x 8 ft. and 7 ft. 6 in. high, supporting the 33,000-volt air-break switch and transformer fuses, is erected on the job.

Company freight trucks or low trailers are used to transport the substation. The labor of erecting the station on the job is approximately six hours for a four-man crew.

Meters

Meters Left Unsealed When Customer Moves

Previous to March, 1940, electric meters were disconnected by Wisconsin Public Service Company when a customer moved out and reconnected when the next customer moved in. On March 1, 1940, an experiment was started to determine what the results would be from leaving residential electric meters connected during vacancies. This experiment was made in territory in which the company furnishes electric service but not gas service and included one of the major communities and a few nearby villages, serving altogether a population of approximately 30,000.

Metermen left a double card hanging in a prominent place in the kitchen of each residence for which a customer had requested that service should be disconnected. The card requested incoming customers to fill in and mail the business reply portion to the company immediately upon moving in. No meter readings were required, as "out" reading of the old customer was to be used as the "in" reading of the new customer.

After four months' trial it was found that 60 percent of the cards were mailed in by customers before the next meter reading date, 30 percent were brought to the office by the customers themselves, 10 percent were picked up by meter readers on the reading dates following the customer's moving in. In only a few cases in which the meter readers could not get in the newly occupied premises when it was necessary for the office to reach the new customers by telephone or mail. In only a few cases did customers request actual readings instead of using the "out" readings of the former occupants as "in" readings for them. The liberal company deposit policy also contributed to the plan's workability.

The plan was then extended and now applies to all residential and farm customers. In electric territory almost all trips to reconnect meters are eliminated. While the new plan is cost saving, the major advantage accrues through good will. Thus far there have been no complaints not easily adjusted and there have been a number of voluntary compliments from customers who brought the cards to the office themselves and expressed appreciation for finding the service available without red tape.

WISCONSIN PUBLIC SERVICE CORP. DATE_____

I HAVE TODAY COMMENCED USING ELECTRIC SERVICE AT:

STREET AND NO. _____ PHONE _____

POST OFFICE _____

PREVIOUS ADDRESS _____

NAME OF ELECTRIC CO. AT PREVIOUS ADDRESS _____

OCCUPATION _____

EMPLOYED BY _____

PRINT NAME _____

WITH vacant-premises meters left unsealed for the customers' convenience, Wisconsin Public Service provides this card for the customer to use in notifying the company that service is resumed.

On the reverse side adjacent to the return address area appears this notice: "The electric service has been left connected for your convenience. We realize that moving time is a busy time, and the electricity has been left available for your immediate use. All that is necessary is to *fill in the attached card completely and mail it promptly.*

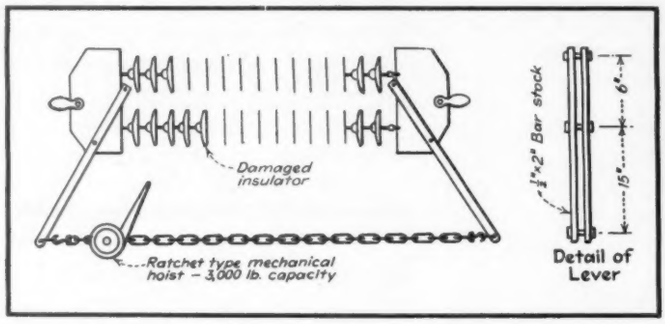
3 TOOLS for Line Work

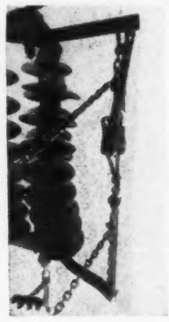
Tower Lines

1. INSULATOR RIG

To the normal difficulties of replacing defective disk insulators in dead-end strings sometimes are added those of getting the equipment to locations which are inaccessible to trucks.

Transmission line crews of the Nebraska Power Company have done this job with equipment weighing not more than 50 lb. by using the rig illustrated. The rig consists essentially of a common ratchet hoist and two lever arms made from $\frac{1}{2}$x2-in. transformer hangers. Each arm is 21 in. long with a fulcrum fin about 6 in. from one end.





RIG used to replace insulators in double or triple string dead-end assemblies in places inaccessible to trucks (left). Rig in place in a three string dead-end assembly (right)

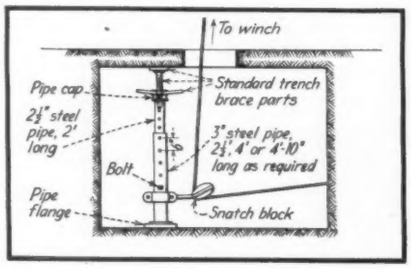
The arms were attached to the insulator yoke strain plates, as illustrated, making use of convenient holes in the yokes to take the fulcrum pins.

By attaching the hoist between the ends of the lever arms it was possible to relieve the tension in the damaged string sufficiently to allow the defective disks to be removed and replaced. While the defective units were being replaced the defective string was supported by rope slings passed around the sound string.

Underground Lines

2. MANHOLE JACK

As an aid to pulling cable in manholes on its underground system the Detroit Edison Company uses a special "manhole jack" to anchor the snatch block through which the pulling line is passed as it leaves the conduit and turns upward to the cable-pulling winch above. As shown in the accompanying illustration, the jack is installed between the floor and roof of the manhole. Adjustment for different manhole heights is provided by telescoping sections of 3-in. and $2\frac{1}{2}$ in. steel pipe drilled at points along their length to take a $\frac{3}{4}$ holding bolt. A standard trench brace is built into the upper part of the jack to provide the necessary axial thrust.



MANHOLE JACK anchors snatch block in manhole during cable pulling operations

Pole Lines

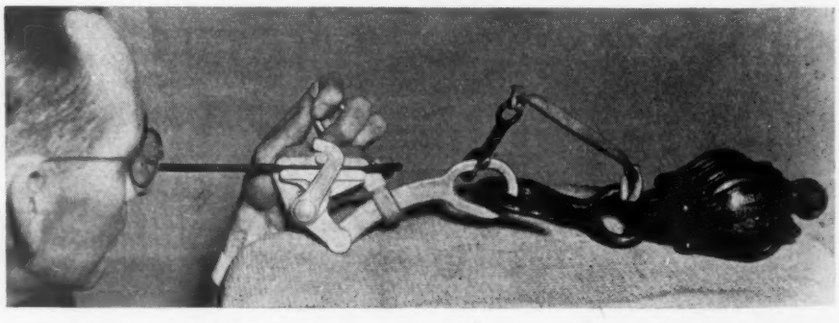
3. GRIP STRAP

A leather or rawhide strap approximately 6 in. long with a large harness snap on one end has been used as a safety device to prevent a potential hazard by the Alabama Power Company.

Wire grips or "come-alongs," used by linemen stringing conductors on poles, often become disengaged when rope in the pulley block becomes slack. The falling grip may inflict injury to workmen below.

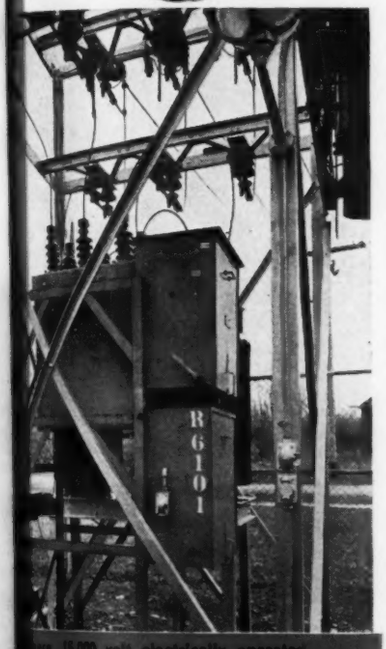
The strap is slit at both ends, for attaching to the eye of the tackle block and for attaching the harness snap, which in turn is snapped into the eye of the wire grip. If, during the pulling of the wire, the grip is disengaged from the wire and block the leather strap will prevent the grip falling.

Entanglement or other interference of the strap with the use of the grip can be avoided if care is exercised to make the strap long enough to allow free use of the harness snap.



LEATHER strap and harness snap are used to prevent wire grip falling if grip and tackle become disengaged

We'll Let These Installations Tell Our Story



...ere, 15,000 volt electrically operated ...talled at the Brockport substa- ...the Niagara, Lockport & Ontario ...mpany.

We could talk about the exceptionally sturdy construction . . . the exclusive inverted contact design . . . the performance under test . . . of Roller-Smith outdoor oil circuit breakers. But, in the final analysis, it's what USERS say that counts, and their opinion is most emphatic when backed-up by repeat orders.

Many power companies and industrial plants have placed initial orders for one or more breakers, and have followed up with repeat orders after having had an opportunity to inspect and test their original installations. Prominent among such repeat customers are:

1. *Puget Sound Navy Yard.* Since one 400 ampere, 50,000 KVA breaker was shipped in June 1939, two additional orders for a total of six breakers have been filled.

2. *New York State Electric & Gas Corp.* installed its first R-S outdoor breaker in the Hamburg Substation early in 1940. Five additional orders for seven breakers have since been completed.

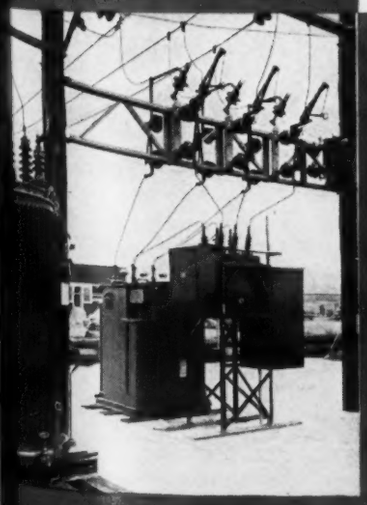
3. *Central Illinois Public Service Corp.* has placed five orders for a total of seven breakers. These are all rated at 50,000 KVA, and four of the breakers are in operation.

4. *Alabama Power Company.* An initial order for one 100,000 KVA breaker was followed six months later with one for five 50,000 KVA units. All are now in operation.

5. *Niagara, Lockport & Ontario Power Co.* has placed orders for several of these breakers since the initial breaker was shipped in the fall of 1939. Breakers of the reclosing and electrically operated types have been ordered.

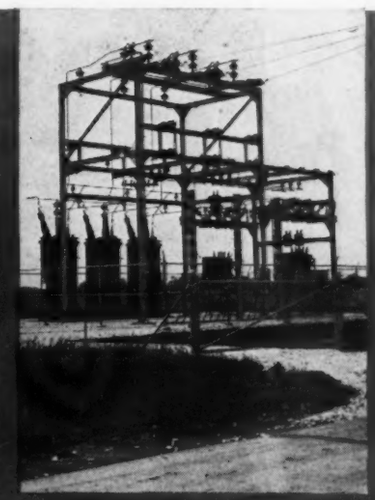
●

Complete information on Roller-Smith Outdoor Oil Circuit Breakers for 50,000, 100,000 and 250,000 KVA interrupting rating can be obtained from the representative near you or from Roller-Smith, Bethlehem, Pa. Write for your copies today.



...ere, 15,000 volt, 50,000 KVA outdoor ...talled at the Shipbottom Substa- ...the Atlantic City Electric Company.

Roller-Smith outdoor oil circuit breakers at the Puget Sound Navy Yard, Seattle, Washington.



Typical of the breakers purchased by the Central Illinois Public Service Company is this installation at Athens substation.

Features of R-S Outdoor Breakers

1. Inverted type high-pressure finger contacts maintain contact pressure until point in stroke where separation is intended to occur.

●

2. Piston and cylinder shock absorber prevents rebounding of contacts on opening.

●

3. Magnetic blowout barriers and arcing horns minimize arcing time and result in low maintenance.

●

4. Ample electrical clearances.

●

5. Main contacts, both moving and stationary are silver plated.

Electrical Measuring and Protective Apparatus

ROLLER SMITH

ROLLER-SMITH COMPANY BETHLEHEM, PENNA.

Switchboards · Metal Enclosed Switchgear · Electrical Instruments
Indoor and Outdoor Oil Circuit Breakers · Air Circuit Breakers

LOAD BUILDING

70 Ft.-Candles for Screw Thread Checks

A long-hour load which contributes to the volume production of highly accurate screw threads in chasers manufactured by the Eastern Machine Screw Company, New Haven, Conn., is provided by a fluorescent lighting installation on the United Illuminating Company's service which delivers 70 ft.-candles at the inspection level.

To insure uniformity of illumination without regard to outdoor conditions and at all hours in which the department is at work, the two rows of inspection benches shown are separated by a barrier 3 ft. high x 30 ft. long which is carried down the middle of the section, and each bench is provided with a 40-ft. run of Miller "Fifty Foot-Candlers" located 4 ft. above the working plane. Two 40-watt tubes per 4-ft. section are used in the reflectors.

The tolerances specified run as close as 0.0005 in. in some of this work, and magnifications of 50 diameters are provided in special equipment for studying the accuracy of the threads. Other work requires from 0.001 to 0.003 in. tolerance, but throughout all the inspection sections of the plant, long-hour intensive lighting is essential to sustained production on a quantity basis with minimum rejects.

FLUORESCENT lighting intensities permit ready inspection of work with tolerance of five ten-thousandths of an inch

•

Electric Warmer Saves Little Pigs

On the Windsor farm of George S. Williams, vice-president and general manager of the Central Maine Power Company, which is fully equipped electrically, a 100-watt heating unit has been installed in an insulated compartment to maintain a comfortable temperature for little pigs of tender age normally subject to high mortality in severe winter weather. The compartment is 36 in. long x $16\frac{3}{4}$ in. wide x $12\frac{9}{32}$ in. deep and easily accommodates the litter of sixteen rooters shown in the illustration.

WARM BROODER shown at right prevents loss of animals in severe weather

The insulation has a minimum thickness of $\frac{1}{2}$ in. and the heating element is mounted under the cover and protected by wire mesh. No thermostat is used and continuous heating is employed during the winter months, with the expectation of being able to operate it during the night only when warmer weather arrives in the spring. A curtain is provided at the front to hold in heat and facilitate the inward and outward movement of the "tenants."

Raising baby pigs is a hazardous undertaking without proper housing and brooding facilities. It is estimated that in many cases the annual loss in new-born pigs from colds, subsequent disease and from being

ENGINEERED SEEING

Goes to Work for America

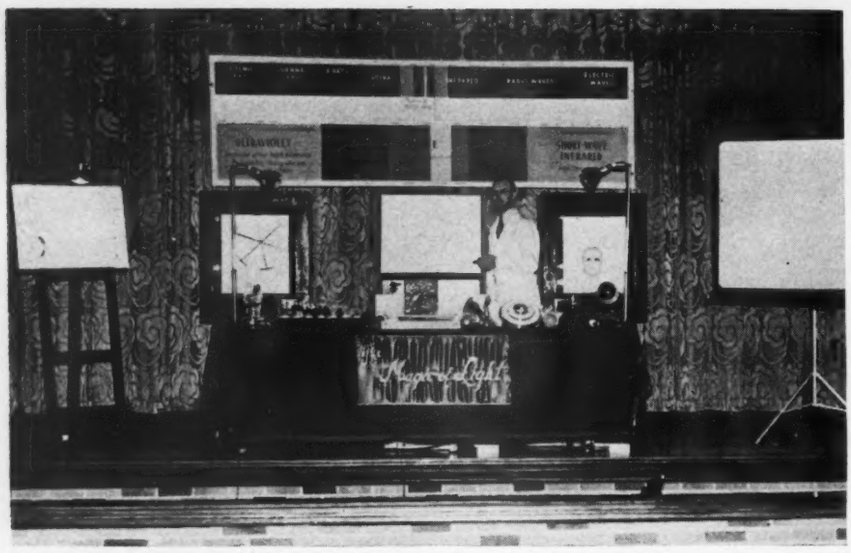
Here's Westinghouse *engineered seeing* doing a 24-hour-a-day job in one of our nation's largest aircraft plants. Eleven thousand two hundred sixty fluorescent fixtures, providing 35 footcandles of glareless light, assure quick, accurate vision for every man at every machine.

In this main factory bay, reflectors are mounted 18 feet high and each is equipped with two 100-watt fluorescent lamps. In all, there are 17,586 Westinghouse fixtures in the complete system of lighting for indoor production and outdoor protection.

Today in Cleveland our Lighting Division stands ready to supply lighting equipment for practically every phase of American war industry. You may obtain full information on this equipment from any of your 117 Westinghouse Electric Supply Company offices or independent Westinghouse lighting distributors.

Westinghouse

LIGHTING EQUIPMENT



POPULAR "Magic of Light" demonstration, originated by Wisconsin Public Service Corporation, ready for action

trampled on reaches 40 percent. The pigs are placed in the electrically heated compartment immediately after birth and the length of time the outfit is used depends on the weather conditions.

•

Lighting Show for Club Presentation

The "Magic of Light" presentation, originated by Wisconsin Public Service Corporation during the winter of 1941 for popular use and used experimentally in part of the company's territory until last fall, has been playing to packed houses.

A 100 percent demonstration lecture of extreme flexibility, the presentation is designed so that it can be suited to any type audience or program requirement. Its length can be varied from 35 minutes to 1½ hours to suit the needs of schools, men's clubs, women's clubs, PTA groups, church clubs and other organizations.

Two lecturers in different divisions of the company are trained to handle the program. Both men tell the same story. The same equipment is used by both and carried from one division to the other by the demonstrator using it. Equipment, costing about $1,000, can bet set up by one person.

No charge is made by the company for the demonstration, the only request being that as large an audience as possible be provided. Groups range in size from 25 to 1,000.

There are nine phases to the complete 1½-hour lecture. Short period lectures choose from these the features most apt to interest the group. Points covered include:

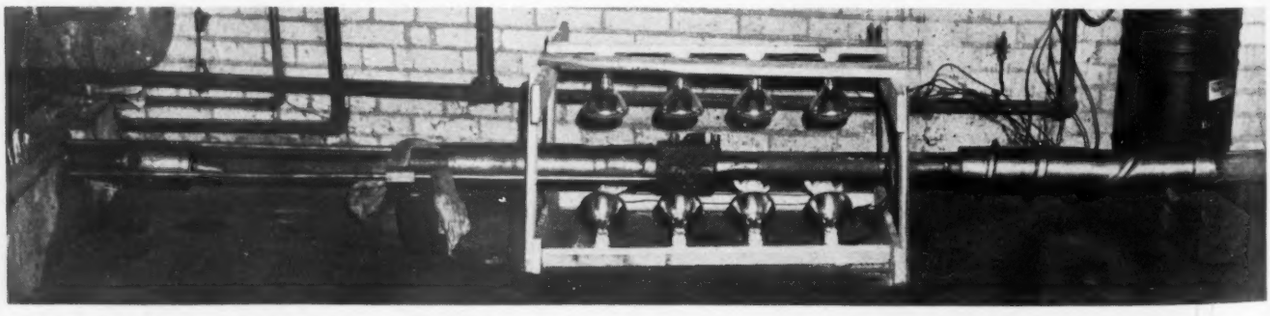
1. Determination of adequacy of illumination—relationship of size, contrast, time of seeing, and illumination, to seeing problem.
2. History of lighting—review of man's efforts to improve lighting with examples of each step and prediction for future.
3. Application of lighting principles—lighting needed for different tasks, developments in home, store, factory, street and school.
4. Fluorescent lighting—how it was developed, how improved, how it operates, how to and how not to use it.
5. Ultra-violet lighting—what is ultra-violet energy? Its possibilities in the home.
6. Black light—"stunt" phase especially suited to evening meetings.
7. Germicidal lighting—light that kills germs, sterilizing bathroom, locker, and other floors, purifies water and dishes.
8. Infra-red lighting—light is revolutionizing heating processes in industry. Dries paint in a few minutes.
9. Smallest and the largest lamps—display of fluorescent tubes; light that bends; importance of proper reflector shades and sizes; new home lighting ideas; part shadows play in home lighting.

•

Infra-Red Lamps Loosen Gears

A new application of infra-red lamps which greatly aids in maintaining equipment used in manufacturing tallow for candles was recently developed for James F. Morse & Company, Boston as a result of tests made in the infra-red laboratory conducted in that city by a group of New England central stations. The Morse company operates a machine for grinding meat products, the equipment having an expeller shaft running sectional worm gears. As the gears become worn it is necessary to replace them. Hitherto this has been a difficult task on account of the wedging of meat particles between the sleeve and the shaft. The job often required a day or more of work with sledge and wedge, with possible damage to the shaft and some hazard to employees.

The problem was solved by installing three rows of four 250-watt infra-red lamps each (3 kw. total) on 120-deg. axes around the shaft, focusing on the "frozen" section. The over-all diameter of the shaft and sleeves is about 7½ in. The lamps are mounted about 8 in. apart on centers and about 6 in. from the metal surface. An exposure of about 35 minutes to this infra-red heating softens up the packed-in particles sufficiently to enable the gear to be worked loose by a gear puller, facilitating cleaning and replacement.



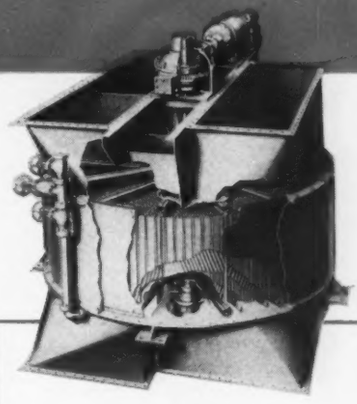
THREE-THOUSAND-WATT BATTERY of infra-red lamps, developed by utilities' laboratory, softens particles jammed between sleeve and shaft and permits easy removal of gears without damage to shaft or hazard to employees

WITH A WARTIME JOB TO DO

In a wartime world where essential materials must be conserved to the limit, the use of preheated air for power plant combustion is no longer an auxiliary service. Rather, it is a key factor, accepted as essential by the designer of today's high-capacity steam generators. Many coals could hardly be pulverized without it; many high moisture fuels could not be burned efficiently without it. By improving combustion, it raises the unit capacity of furnaces. By increasing heat recovery, it conserves important quantities of fuel.

Among the several methods available for preheating combustion air, the economic balance ordinarily favors a Ljungstrom. But now the need for conserving steel adds an important new factor to the equation. Typically, a Ljungstrom Air Preheater weighs about *one-third* that of an alternate type meeting the same conditions. (In a specific case, 63,640 lb. as against over 200,000 lb.) To this direct saving, moreover, must be added the extra structural materials necessary to support the units in each case.

In recent months, every major builder of high-efficiency power plants has included Ljungstrom Air Preheaters in one or more jobs vital to America's war effort. In the coming months, we will do our utmost production-wise to carry forward the *conservation program* which the installation of every Ljungstrom Air Preheater sets in motion.



The *continuous regenerative counterflow* principle of the Ljungstrom Air Preheater accomplishes the maximum transfer of heat from flue gas to combustion air with the minimum of equipment weight and size. An informative bulletin explaining how this is accomplished will be sent on request. Just write:

THE

AIR PREHEATER

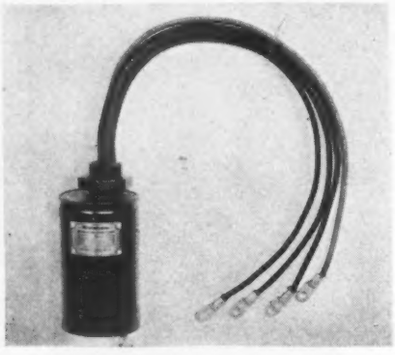
CORPORATION

Executive Offices: 60 East 42nd Street, New York, N. Y. • Plant: Wellsville, New York

NEW EQUIPMENT

Meter Protector

Indoor watt-hour meter protector has been developed for preventing damage due to lightning surge voltages. It consists of



Type "A" watt-hour meter protector; circuit voltage range 100 to 575 volts on three-phase circuits. **Westinghouse Elec. & Mfg. Co.**, East Pittsburgh, Pa.

porous block elements and series gaps inclosed in an aluminum case filled with a non-inflammable compound. The unit can be mounted through a knockout in a connection box on which meter is mounted.

•

Bridge

Instrument for production measurement of resistances features a selection of tolerance percentages; "plus" and "minus" tolerances may be set individually and independently of each other. This self-contained instrument has a galvanometer and a working standard of six decades totalling 1,111,110 ohms, variable in one-ohm

"No. 621-A" percent limit bridge; tolerance percentages from 0.25 to 10 percent. **Shallcross Mfg. Co.**, Collingdale, Pa.

increments, and may be used as an ordinary Wheatstone bridge to measure actual resistance.

•

Current Transformers

Types "MKE," "K2E" and "K3E" current transformer; 5, 8.7 and 15 kv. primary ratings respectively. **Allis-Chalmers Mfg. Co.**, Milwaukee, Wis.

Three new types of current transformers conform to standard major dimensions for three standard primary ratings adopted by EEI and NEMA, making possible free interchange of this equipment on all metering installations. Designed for heavy burden accurate metering, relay and control applications, they are said to be built for heavy duty jobs and large emergency loads. Liberal core sections and large copper conductors, it is claimed, contribute to their cool operation.

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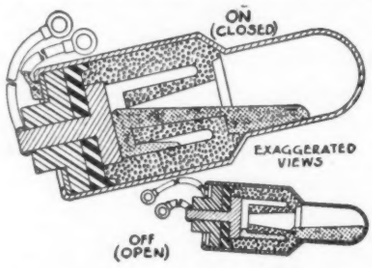
Mercury Switch

Newly developed device for mercury switching has two tails of mercury pulling



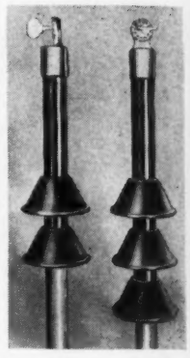
"Double-Flow" mercury switch; capacities 10, 20, 35 and 65 amp. **Durakool, Inc.**, 1029 North Main St., Elkhart, Ind.

in opposite directions, over a ceramic barrier until severed, preventing a double contacting, it is claimed, where vibrations exist. When closing, the two approaching bodies of mercury pile up a double thick electrical conductor. It is said to be suitable for slow rolling motion or high-speed mechanical snap action.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Storm Tool

Maintenance tool for hot-line work is equipped with special rubber insulators to prevent moisture absorption and to deviate streams of water running down. It is not intended for work in the rain over long periods but it is claimed should be invaluable in cases of extreme emergency.



"Tips" emergency storm tool. **A. B. Chance Co.**, Centralia, Mo.

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Spray Ring

Spray ring; header 1¼-in. copper tubing with 90-deg. nozzles spaced 1 ft. apart; 15 to 20 gal. per minute. **John A. Brooks Sprinkling Systems**, 20122 Livernois Ave., Detroit, Mich.

For increasing performance of self-cooled transformers a header ring with nozzles underneath and a hose connection to a water supply functions as cooling rain. It is attached to iron brackets that are held in place by transformer cover plate bolts. Spray may be directed at crown of cooling tubes and have overlap for cooling inner tubes and tank. Automatic operation may be obtained by a solenoid valve energized by transformer overheating alarm gage.

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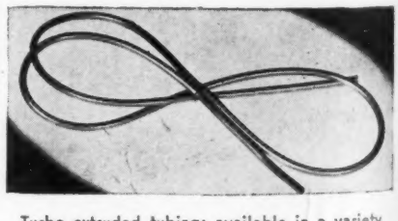
Insulation

Recently developed sleeve insulation of synthetic material is said to be resistant to temperatures 30 to 40 deg. below zero and to insure retention of its original shape and size, regardless of heat and cold variations within reasonable limits.



Turbo extruded tubing; available in a variety of colors and in standard A.S.T.M. diameters. **William Brand & Co.**, 276 Fourth Ave., New York, N. Y.

New Idea in Marine Radio Design Speeds Installation . . . Saves Space

Off the ways . . . and on the way, go America's Liberty Ships . . . mile after mile of new cargo vessels, stretching off endlessly down the ocean roadway toward America's allies and united victory. And this vast Armada of Liberty's Arsenal is a credit to the shipbuilders' craft.

Every cubic foot has been made to account for itself against the grim demand for precious cargo space. For example, in the radio room, not eight or ten, but *one* compact marine radio telegraph unit supplies all needed communications facilities.

This all-in-one radio unit makes it possible to do at the factory practically all wiring and other work usually done aboard ship. Installed in one-fifth the time normally required — practically ready to tune in and plug in—it was designed and manufactured for the first 312 Liberty Ships by I. T. & T.'s subsidiary, The Federal Telegraph Company.

The compact, all-in-one radio unit designed and manufactured for the Maritime Commission by I. T. & T.'s subsidiary, The Federal Telegraph Company.

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

67 Broad Street, New York, N. Y.

NEWS ABOUT PEOPLE

C. A. Mayo to Manage Salem Properties

Clarence A. Mayo, manager of the Eastern Massachusetts Electric Co., Salem, Mass., has also been appointed manager of the Salem Gas Light and Salem Electric Lighting companies.

Mr. Mayo is a graduate of the University of Maine and entered the utility field in 1910. He was with the Malden (Mass.) Electric Co. from that time until 1931, with the exception of four years spent as superintendent of the Peoples Gas & Electric Co., Oswego, N. Y. He was transferred from his position as electrical engineer in Malden to Salem, where he became assistant manager of the Eastern Massachusetts company, a transmitting and wholesaling organization identified with suburban utilities north of Boston. In 1933 he was made manager, and Mr. Mayo will continue in that post in addition to managing the Salem utilities, of which he has been assistant manager for about two years.

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▶ THORSTEN ERICSON, vice-president of Asea (General Electric of Sweden), has been appointed president. Mr. Ericson will succeed ARTHUR LINDEN, who is retiring on October 1 as president. Mr. Linden will stay on the board of directors and is becoming chairman of various subsidiaries of Asea.

▶ W. L. ABBOTT, retired chief operating engineer, Commonwealth Edison Co., Chicago, Ill., has been named recipient of the Washington Award for 1942 by the Washington Award Commission.

▶ FREDERIK BORCH has been named electrical engineer of the Cleveland Electric Illuminating Co., succeeding H. L. Wallau.

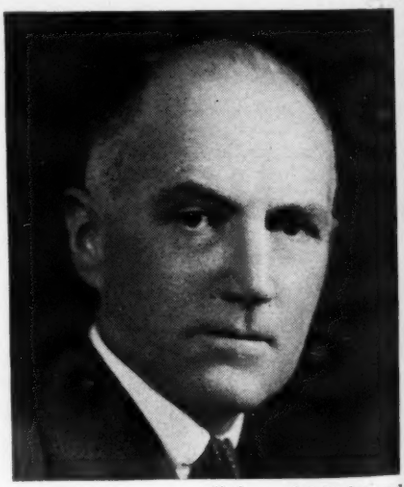
▶ MAJOR EDWIN H. ARMSTRONG, professor of electrical engineering at Columbia University, who developed frequency modulation in radio, was made the recipient of the John Scott medal at the midwinter meeting of the American Philosophical Society held recently in Philadelphia.

▶ DONALD T. MCDONALD has been appointed manager of sales promotion and publicity, a newly created department of the Crocker-Wheeler Electric Manufacturing Co. This department, according to C. F. Poirier, vice-president, has been established as the basis of a broad scale program of post-war planning. Before joining the Crocker-Wheeler organization in 1941, Mr. McDonald was with the Westinghouse Electric & Manufacturing in the capacity of advertising section head at its East Pittsburgh headquarters. He handled promotional activities and publicity for that company on the Pacific Coast, and later was sales manager for the northwestern district of the Westinghouse Lamp Co. Preliminary sales promotion plans, designed to meet anticipated post-war industrial conditions, are now being developed by Crocker-Wheeler in the eastern and New England states. Other districts will be included progressively, until the program is nation-wide in scope. At present Mr. McDonald is making his headquarters in the New York offices of the company.

Towers Made President of Ford, Bacon & Davis

Ford, Bacon & Davis, Inc., engineers, New York, has announced the election of James F. Towers as president. William von Phul, who was president from 1922 to date, will actively continue as chairman of the executive committee.

A native of Rome, Ga., and a graduate of Georgia Institute of Technology, Mr. Towers started as an engineer in the operating department of the Tennessee Coal, Iron & Railroad Co. at Birmingham, working up to assistant general superintendent of open hearth furnaces. He was then transferred to the Illinois Steel Co. at Gary and after various assignments became assistant general superintendent in charge of coke ovens. In 1918 Mr. Towers joined the organization of Ford, Bacon & Davis, and shortly thereafter became a



Underwood & Underwood

J. F. Towers

vice-president. In recent years he has been in charge of operations. In January, 1941, Mr. Towers was appointed assistant director of priorities of OPM at Washington, remaining there until May. He is a member of the American Society of Mechanical Engineers and of

the complete and lasting
cable protection provided by

ORANGEBURG CONDUITS

is contributing to the continuity of light and power service so vital to the refining and other process industries.

ORANGEBURG *Standard*
for installations underground *with* concrete encasement — for main service and other installations where duct banks of four or more ducts are required.

ORANGEBURG NOCRETE
for installations underground *without* concrete encasement — for single, double, and triple duct service.

Photograph by Galloway

"UNDERGROUND" FOR 49 LONG YEARS

ORANGEBURG HAS BEEN A LASTING NAME

Build for tomorrow with

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GENERAL ELECTRIC SUPPLY CORP. GRAYBAR ELECTRIC CO., INC.

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TAP SWITCHES

PROVED PERFORMANCE makes Ohmite Resistors, Rheostats and Tap Switches a logical choice for important electrical control applications. You'll find them on duty today in industry and in the armed forces. Special design and construction features insure dependable, trouble-free service day-in and day-out.

The extensive range of types and sizes in stock or special units makes it easier to meet each need. Resistors from 1 to 1500 watts—fixed, adjustable or tapped; regular precision or non-inductive. Rheostats in ten wattage sizes from 25 to 1000 watts. Tap switches rated at 10, 15, 25, 50 and 100 amperes, A.C. Ohmite Engineers will be glad to help you make the right selection.

Send for Catalog and Engineering Manual No. 40

Most complete helpful reference on Resistors, Rheostats and Tap Switches. 96 pages of useful data and engineering information. Write on company letterhead for your copy today.

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the Blast Furnace and Coke Oven Managers Association.

Early in his career Mr. von Phul was connected with the Edison Electric Co. of New Orleans and with the Cincinnati Gas & Electric Co. In 1905 he joined the staff of Ford, Bacon & Davis, became a partner in 1912 and in 1922, upon the incorporation of the firm, Mr. von Phul was made president. He is a fellow of the American Society of Mechanical Engineers and the American Society for the Advancement of Science, and a member of the American Society of Civil Engineers, Louisiana Engineering Society and the American Society of Municipal Engineers.

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R. J. Wensley Assumes New Duties with I-T-E

In addition to the election of W. M. Scott, Jr., as president, the I-T-E Circuit Breaker Co., Philadelphia, Pa., has recently announced the appointment of Roy J. Wensley, formerly assistant general manager, to the position of general manager (ELECTRICAL WORLD, February 7, page 114). Mr. Wensley joined I-T-E in 1935, taking charge of all modernization projects in production of air circuit breakers and switchgear.

R. J. Wensley

He became associated with the staff in the period which marked the beginning of the broadening use in industry of air-immersed protective apparatus. It was a turning point.

By 1935 Mr. Wensley had served some 18 years in engineering capacities at Westinghouse Electric & Manufacturing Co., principally with switchgear, refrigeration and electrical relays. His training eminently qualified him for his work at I-T-E, and rapid progress was made. His original appointment in 1935 was as assistant general manager, and the title was conferred as a part

L-M Connector now stronger than ever

The L-M Connector is better now than ever. Its body of a new cast bronze alloy, machined all over, gives exceptional high strength and adds years of usable life.

Accurate overall machining results in perfect threads which give remarkably high pressure contact between conductors with low applied wrench force. Machining also gives the smooth surfaces and rounded corners which protect the conductor and make the connector easy to handle. The wide surfaces and V groove pad insure good current carrying capacity and prevent slippage.

On your next order specify L-M Connectors.

LINE MATERIAL CO.
MILWAUKEE, WIS.

EASY TO ASSEMBLE METAL PARTS ON

ILLINOIS POTHEAD PORCELAIN

☆ The top and bottom surfaces of ILLINOIS Pothead Porcelain are absolutely parallel. End surfaces are ground by special machinery when required.

Perfect assembly, so important to the pothead manufacturer, is assured—a feature which increases production efficiency.

Another step in the manufacture of ILLINOIS Pothead Porcelain is that of gaining exact dimensions—this is accomplished through profile control which makes possible uniform contour as well as accurate dimensions.

- HIGH DIELECTRIC STRENGTH
- HIGH MECHANICAL STRENGTH
- EXACT DIMENSIONS AND UNIFORMITY

ILLINOIS ELECTRIC PORCELAIN CO. *Macomb, Illinois*

SAVE HOURS OF WORK

ON DEFENSE JOBS WITH THESE GREENLEE TOOLS

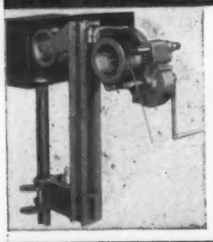
★ ★ ★ ★ ★

Cut labor costs and save vital hours on your defense jobs by turning to a better use of tools. Greenlee Tools are saving hundreds of contractors on defense jobs from 15 to 75% in time and labor costs by making the work easier and faster for the man on the job.

COMPLETE LINE OF BENDERS

For any bending job there's a Greenlee Bender. Small hand benders and powerful hydraulic benders for conduit, pipe and tubing from ¼ to 4½-inch size. Benders that are easily operated by one man, save the cost of many manufactured bends and fittings, are compactly built in one unit, and are easily carried to the job and set up.

No. 765 CABLE PULLER



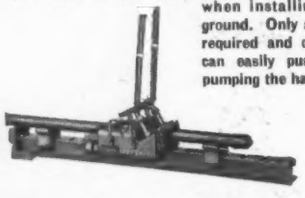
This handy Greenlee Cable Puller clamps right on to the conduit through which cable is pulled, is easily carried to the job, can be set up in a jiffy, and is easy for one man to operate with one or two cranks and will save many hours of work when pulling in cable.

KNOCKOUT TOOLS

Enlarge holes without long tedious drilling, reaming and filing with Greenlee Knockout Punches and Cutters. This handy tool is inserted in a knockout or a small drilled hole and a smooth accurate hole can be quickly cut by turning the drive nut with an ordinary wrench.

HYDRAULIC PIPE PUSHERS

Greenlee Pushers eliminate digging long trenches, tearing up lawns, breaking through concrete, backfilling, and tamping when installing pipe underground. Only a short trench is required and one or two men can easily push the pipe by pumping the handles.



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Find out how these and other Greenlee Tools for the Electrician, Carpenter, and Plumber can help speed up your jobs . . . write for Catalog 33E.

GREENLEE TOOL CO.
1802 COLUMBIA AVE.
ROCKFORD, ILL.

of a plan to have him assume the position of general manager in due course.

•

▶ DR. C. F. RASSWEILER, who joined Johns-Manville Corp. last June as director of research, has been appointed a vice-president of the corporation. In his new office Dr. Rassweiler will continue in charge of the company's research and development activities, which are now largely devoted to converting the full production capacity of Johns-Manville to war uses.

▶ ARTHUR T. COX, JR., has been elected vice-president of the Lincoln Electric Railway Sales Co., with headquarters at Chicago, Ill. Mr. Cox had been sales manager of the Bettendorf Co., Bettendorf, Iowa, prior to his new appointment. He was formerly a district sales manager in the industrial sales division of the Lincoln Electric Co.

▶ JAMES A. BENTLEY, vice-president of Carrier Corporation, has been appointed head of the company's newly created Eastern division, according to an announcement by J. I. Lyle, president. Mr. Lyle said the appointment marks the initiation of a new marketing plan designed to expedite the handling of Carrier's increasing war business, to simplify field operations and to bring closer co-operation between dealers and branches.

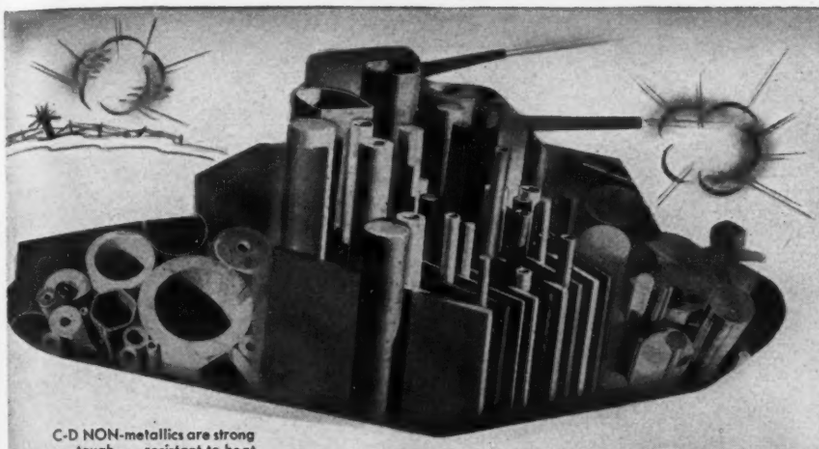
▶ OTTO E. ECKERT, general manager of the Lansing (Mich.) Board of Water and Electric Light Commissioners, has been appointed by Gov. Murray D. Van Wagoner as a member of a state defense council subcommittee on engineering to deal with problems of engineering presented by the war and to participate in post-war planning.

▶ W. T. CLARK has been named secretary of the Electrical League of Cleveland, to succeed Ralph H. Jones, resigned. Mr. Clark has been with the League since 1936, handling exhibits, displays, special promotions and lecture work. Following graduation from Texas A. and M. College he joined the engineering department of the Edison Lamp Works at Harrison, N. J. Later he was transferred to the advertising and sales promotion department of the company. Before joining the League, Mr. Clark was in charge of lighting sales for the Pennsylvania Power & Light Co., and prior to that he was associated with the Nela Park sales promotion department.

▶ HENRY B. DUFFUS, formerly supervisor of safety and plant protection at the Westinghouse East Springfield, Mass., works, has been appointed mechanical safety engineer in the headquarters medical department at East Pittsburgh. Dr. Duffus' duties will in-

QUIT STABBING POLES
● Use the new Multipoint Cant Hook. Its 6 points, ¼ in. x ½ in. in size, hold better than a single long point. Leave no deep stab holes where water collects and rot starts—do not damage the creosote treatment. The Multipoint Cant Hook grips more securely even the smallest diameter poles which are so difficult to handle with the standard single point hook—spreads strain over wider area—is self-releasing. Furnished in 3 sizes for handling poles up to 22 inches in diameter. Multipoint speeds up pole handling in the yard—eliminates damage—saves time and money. Made by the American Fork & Hoe Company, Cleveland, Ohio.
STURDETOOLS
a TRUE TEMPER PRODUCT
STURDETOOLS
MULTIPOINT CANT HOOK
6 points ¼"x½" in size grip the pole securely but leave no deep hole to encourage rot and decay.
Furnished in small, medium and large sizes for handling poles up to 22" in diameter. Prices and complete description on request.
Distributed by
JOSLYN MFG. AND SUPPLY CO.
Executive Offices
20 North Wacker Drive • Chicago, Illinois
Branches and Warehouses with Complete Stocks in Principal Cities of the United States

To Help Industry Win



C-D NON-metallics are strong . . . tough . . . resistant to heat —cold—chemicals—oil. Made in standard size sheets, rods, tubes, readily fabricated.

IN THE BATTLE AGAINST TIME

CONTINENTAL-DIAMOND offers five basic NON-metallic materials to help you solve your "What Material?" problem. DIAMOND Vulcanized FIBRE . . . DILECTO laminated phenol fibre . . . CELORON molded fabric plastics and silent gears . . . MICABOND mica insulation . . . VULCOID.

Four modern, completely equipped plants strategically located in this country and one in Canada, assure a continuous flow of parts and materials.

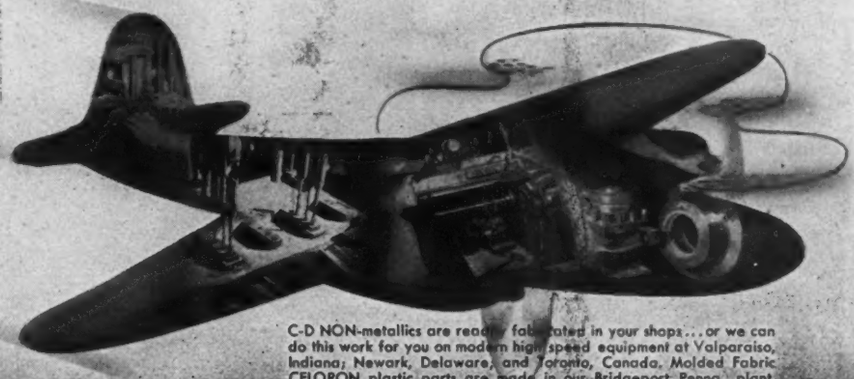
WHAT MATERIAL?

You can get help in your "What Material?" problems from the modern, completely equipped C-D Research Laboratory. Here you will benefit from a vast store of "know how" which we have accumulated during 46 years of helping customers solve "What Material?" problems.

Our recommendations will be unbiased because we make many types of NON-metallic materials.

Write today for booklet GF-12... it tabulates technical data and information on standard sizes and forms of all C-D NON-metallic materials.

Standard sheets, rods and tubes from service stocks in San Francisco; Valparaiso, Indiana; Newark, Delaware; Bridgeport, Penna.; and Toronto, Canada.



C-D NON-metallics are ready fabricated in your shops... or we can do this work for you on modern high-speed equipment at Valparaiso, Indiana; Newark, Delaware; and Toronto, Canada. Molded Fabric CELORON plastic parts are made in our Bridgeport, Penna., plant.

Continental-Diamond FIBRE COMPANY

"Manufacturers of Laminated Plastics Since 1911" — NEWARK • DELAWARE

Crapo
GALVANIZED STEEL
STRAND

Combines All 4

1—HIGH STRENGTH
2—RUGGEDNESS
3—LONG LIFE
4—ECONOMY

All the inherent strength and ruggedness that steel alone provides are combined with long life and definite economies in *Crapo* Galvanized Steel Strand. Each size and grade develops the full tensile strength of the steel in its complete cross-section. The heavy, ductile, tightly-bonded zinc coating—applied by the famous *Crapo* Galvanizing Process—affords lasting protection against corrosion, extends the life of the strand beyond the normal period for replacement.

Low first cost, workability in the field, consistent, trouble-free performance and low maintenance expense characterize the service history of this time-tested product. There is a size and grade of *Crapo* Galvanized Steel Strand for every practical need. Consult the distributor of *Crapo* Galvanized Products near you or write direct for further information!

INDIANA
STEEL & WIRE CO.
MUNCIE, INDIANA

clude safety work at the 24 plants and 33 district manufacturing and repair departments of Westinghouse throughout the country. One of his chief responsibilities will be the continued development of safety devices installed in machines to protect the operators. He is vice-chairman of the automotive and machine shop section of the National Safety Council and is also a special agent of the Department of Labor's National Committee for Conservation of Man Power in Defense Industries.

▶ C. R. HAYDEN, formerly manager of the Hollister district of the Coast Counties Gas & Electric Co., Santa Cruz, Calif., has been appointed district manager of the Imperial division in El Centro. W. R. SNYDER, formerly company representative in the Valley division, office in Los Banos, is now district manager of the Hollister district with office in Hollister.

OBITUARY

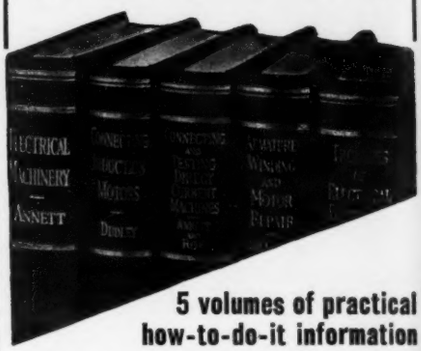
Horace L. Mann

Horace L. Mann, president of Buffalo Niagara Electric Corp., died on February 10 at his residence in Buffalo, N. Y., in his seventieth year.

One of the pioneers in the development of the electric utility business in that section of the country, Mr. Mann was connected with Buffalo Niagara Electric Corp. and its predecessor company for the past 33 years, having joined Buffalo General Electric Co. in 1909 as treasurer. In 1926, when Buffalo Niagara & Eastern Power Corp. was organized, Mr. Mann was made vice-president and treasurer and a year later became a director. In 1930 he was elected president of Buffalo General Electric Co., predecessor of Buffalo Niagara Electric Corp., the position he

Blackstone Studios

Every phase of electrical maintenance and repair work covered in this Library



5 volumes of practical how-to-do-it information

Every man concerned with the care and repair of electrical machinery should have these practical books, with their helpful tables, diagrams, data, methods and kinks. Every one of the five volumes is jammed to the covers with sound, how-to-do-it information—the kind you have to have when anything goes wrong. Liberal use has been made of practical data and practice in repair shops so as to combine the good features of a library of methods with handbook information covering these methods.

Electrical Maintenance and Repair Library

2042 pages, 1721 illustrations and diagrams

These books show you how to

—install all types of motor and generator units;
—locate breaks in armature windings and do a workmanlike job of rewinding;
—know just what is wrong with an electrical machine and take charge of installation and maintenance work;
—make accurate tests of switchboards and apparatus and correctly balance the power with the load;
—handle every sort of wiring job;
—show competence, whether it be in the use of a Stillson wrench of a Wheatstone bridge.

New trouble-shooting book

Now, in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a new book full of helpful maintenance information, special trouble-shooting charts, explanation of symptoms and causes of machinery troubles, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

10 days' examination
Easy monthly payments

We want you to examine this Library for 10 days. If you don't want them at the end of that time, there's no obligation to keep them. On the other hand if you decide you want the help these books can give, start the small monthly payments then, and in a short time the books are yours, right while you have been using them. Send the coupon today.

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Send me Electrical Maintenance and Repair Library, 5 volumes, for 10 days' examination. If I find the books satisfactory, I will send you $1.00 in 10 days, and $2.00 a month until $15.00 has been paid. Otherwise I will return the books postpaid.

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Know What's UNDER the Trade-mark Before You Buy MOTORS!

PROUD as we are of the Fairbanks-Morse trade-mark, we urge that before buying you look beyond the trade-mark—*look at the motor.* For we know, and you know, that it's the motor and not the trade-mark that runs machines.

And because we believe you know motor quality when you see it, we ask you to look at the construction of an F-M Motor point by point. Compare the exclusive F-M Copperspun Rotor, for instance, with the rotor in any other squirrel cage motor. You'll say, we're sure, that you want windings centrifugally cast of COPPER, rather than of some less suitable metal.

Would you like to look further into the construction advantages that give F-M Motors their proved stamina? A post card or telephone call will bring you a demonstration. Fairbanks, Morse & Co., Dept. B27, 600 S. Michigan Ave., Chicago. Branches and service stations throughout the United States and Canada.

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FAIRBANKS·MORSE F-M MOTORS

DIESEL ENGINES ELECTRICAL MACHINERY MAGNETOS RAILROAD EQUIPMENT WASHERS-IRONERS STOKERS
PUMPS MOTORS FAIRBANKS SCALES WATER SYSTEMS FARM EQUIPMENT AIR CONDITIONERS

held at the time of his death. He was also vice-president and director of several western New York operating companies of the Niagara Hudson Power System.

•

Lynde Bradley

Lynde Bradley, president and cofounder of the Allen-Bradley Co., Milwaukee, died in that city on February 8, after a long illness. He was 64 years of age. Mr. Bradley at an early age showed an interest in things electrical, building his first control in the basement of his Milwaukee home. In 1898 he opened an X-ray laboratory and he and one of his customers, Dr. Stanton Allen, a Milwaukee orthopedic surgeon, became close friends. Mr. Bradley interested Dr. Allen in the industrial possibilities of an electrical control for cranes on which he had worked and in 1909 the Allen-Bradley Co. was organized. Suffering from heart trouble, Dr. Allen left Milwaukee shortly after for California, where he died in 1916. Lynde Bradley, with the assistance of his brother, Harry, now vice-president and treasurer, started the small Milwaukee plant on the path to success.

•

▶ WILLIAM J. FREED, of the sales staff of the Triangle Conduit & Cable Co., Inc., New Brunswick, N. J., died on February 9.

▶ DANIEL F. DUNN, manager of the order service department of the General Electric Co., Boston, since 1937, died at Boston February 13. He was born in Barre, Mass., in 1882, and was with the company at the Lynn and Schenectady plants before going to Boston.

▶ DAVID WISHON, for many years Bakersfield district manager of the San Joaquin Light & Power Corp., and brother of A. G. Wishon, founder of the company, died in Bakersfield on December 15. He joined his brother in the Mt. Whitney Power Co. at Visalia in 1894. He went with the San Joaquin in 1902 as engineer in charge of construction of the Tule River power development. In 1918 he became district manager at Bakersfield, holding that position until his retirement in 1937.

▶ ABEL REYNOLDS, 71, general manager and treasurer of the New England Water, Light & Power Associates, Providence, and for many years identified with the operation of utilities in southern New England, died in Providence, R. I., February 12. He was born in Providence and entered the service of the Narragansett Electric Lighting Co. of that city in 1899, subsequently becoming secretary to the vice-president and then engineering aid to Arthur B. Lisle, then its general manager, remaining with the company about 30 years. He was superintendent of the Barrington branch when the company was acquired by the New England Power Association, and then became associated with Mr. Lisle in the management of utilities in the electrical and water supply fields.

▶ NATHAN H. SUREN, 88, for many years chief engineer of the Gamewell Fire Alarm Telegraph Co., Newton, Mass., prior to retirement about 12 years ago, died at Providence, R. I., January 27. He was a native of Greece and came to this country when 23 to complete his engineering training at Cornell University.

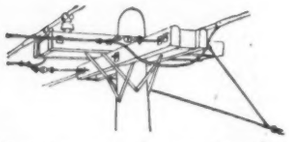
▶ WILLIAM N. GLADSON, dean emeritus of the college of engineering and vice-president emeritus of the University of Arkansas, Fayetteville, died on October 18. He joined the staff of the University of Arkansas in 1894 as professor of electrical engineering and in 1913 was appointed dean of the college of engineering and vice-president of the university, serving until his retirement in 1936. He was made emeritus vice-president and dean of the college of engineering in 1937. Early in his career Dr. Gladson was connected with the Thomson-Houston Electric Co. in Chicago as engineer from 1888 until 1892, when he became assistant professor of electrical engineering at Ohio State University. Then he became identified with the Westinghouse Electric & Manufacturing Co. at the Chicago World's Fair. Dr. Gladson was engineer in charge of the Arkansas Water Power Survey 1909-10, a member of the Naval Consulting Board 1917-18, and carried on consulting practice from 1917 until 1938.

▶ JOHN T. WALTHER, head of the electrical engineering department of the University of Akron, died on November 4. Following graduation from the University of Michigan, he worked with the Westinghouse Electric & Manufacturing Co. in East Pittsburgh, Philadelphia and Cleveland, in the engineering and sales departments until 1917, when he joined the Massillon Gas & Electric Co., Massillon, Ohio, as power sales engineer. During that year he worked for the Firestone Tire & Rubber Co., Akron, as electrical engineer in charge of testing and later transferred to the Firestone Steel Products Co., rim plant, of Firestone Tire & Rubber Co., as electrical engineer in charge of laying out the switchboard and all wiring of the new plant. In 1920 he became an instructor of electrical engineering at the University of Akron and later professor of electrical engineering, being appointed head of the engineering department there in 1923.

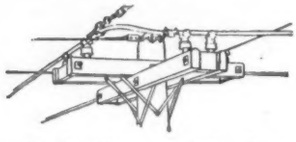
SAVE $5.00 A TURN OR DEADEND

on 000 to 1,500,000 C.M. cable with

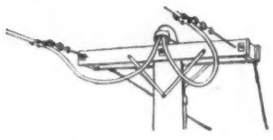
Matthews Cable Clamps



Shows how strain caused by right angle taps can be relieved



Outside Turns, Straight Guys



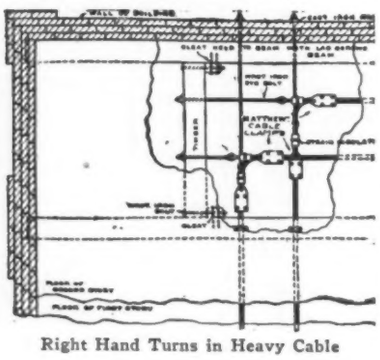
Deadending Two Cables

Order Number 2 for use on D.C. Cable or Number 3 for use on A.C. Cable.

Hundreds of thousands of these Clamps have been sold.

Every order for 000 to 1,500,000 C.M. Cable should include an order for Matthews Cable Clamps for every corner or deadend.

Write for Bulletin C.

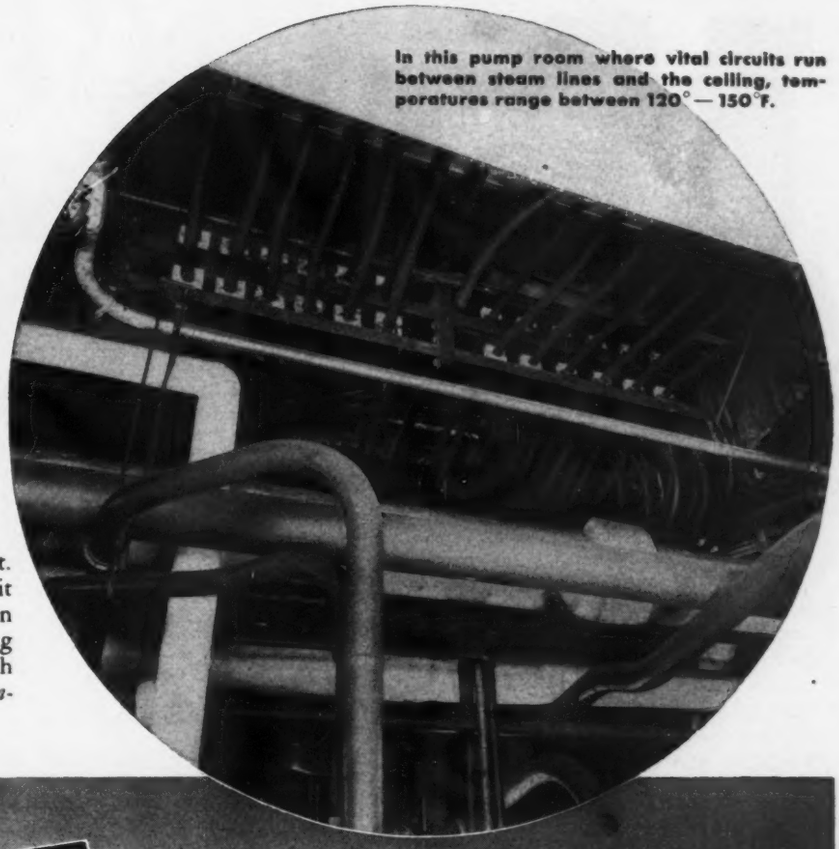


Right Hand Turns in Heavy Cable

W. N. MATTHEWS CORPORATION

ST. LOUIS, U. S. A.

Installations like this →



In this pump room where vital circuits run between steam lines and the ceiling, temperatures range between 120° — 150°F.

If your plant has any power, control or lighting circuits keeping company with steam lines, boilers, furnaces, lehrs, soaking pits, or operating anywhere else under high temperatures — you'll have trouble sooner or later if the wire isn't *permanently insulated* against heat. You know what heat does to wire — it bakes ordinary insulation to a crisp — then comes failure, shut-downs and a rewiring job that could have been avoided with Rockbestos, *the wire with permanent insulation.*

Call for Insulation like this →

Rockbestos A.V.C. Power Cable (Underwriters' and National Electrical Code Type AVA) for locations where heat and moisture, oil, grease and corrosive fumes make trouble, has a maximum operating temperature of 110°C. (230°F.) because of these insulation features.*

① Tough, rugged asbestos braid impregnated with inert compounds that insure positive protection against heat, flame, moisture, oil, grease and corrosive fumes.

② Felted asbestos which serves as a heat-seal against high ambient temperatures.

③ High dielectric, moisture resistant, asbestos-sealed insert of lubricated varnished cambric.

④ Another felted asbestos wall which provides protection against conductor-heating overloads and copper-melting arcs.

* This type of insulation also used in lighting wire, control cable, motor lead cable and other Rockbestos A.V.C. constructions.

Plan now to prevent equipment outage and keep production moving with *permanently insulated* Rockbestos. Anticipate your minimum footage requirements and furnish preference rating forms when ordering. For a catalog showing many of the 118 standard constructions write to:

Rockbestos Products Corp., 834 Nicoll St., New Haven, Conn.

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

MANUFACTURING-MARKETS

Manufacturers' Net Shows 103% Gain

Total assets of 31 corporations engaged primarily in the manufacture of electrical supplies and equipment other than electrical appliances were 831 million dollars as of December 31, 1940, as compared with 739 million in the previous year, according to the Securities and Exchange Commission. Two corporations, General Electric Co. and Westinghouse Electric & Manufacturing Co., reported in 1940 assets which represented approximately 88 percent of the industry total. Some of the more important items in the report are presented in the following table:

Combined Totals	(Millions of Dollars) 1940	1939	Percent Change
Net Sales	886	667	+33
Net profit from operations	150	74	+103
Net profit after all charges	87	63	+38
Total dividends	74	54	+37
Total assets	831	739	+12
Capital stock	354	356	—1
Surplus	226	212	+7
Net profit from operations in percent of sales	16.9%	11.0%	
Net profit after all charges in percent of sales	9.8%	9.4%	
Ratio of current assets to current liabilities	3.29	5.21	

•

Silex Reports 31% Rise in Sales in 1941

A 31 percent increase in sales is reported by Silex Co., Hartford, Conn., for 1941 compared with 1940, or a net of $1.83 per share against $1.48. Gross revenue totaled $3,407,584 and surplus increased from $579,820 to $714,966. The company's tax bill rose 105 percent.

President Frank E. Wolcott stated that war orders are increasing rapidly; that business booked in January, 1942, was 75 percent above a year ago, and shipments were up 50 percent. A special vitreous china has been substituted for metal parts in the standard glass coffee makers. The company's operations were not seriously affected in 1941 by priorities and plans have been completed to employ plastics and vitreous china extensively for material which may run shorter in supply. Should an acute shortage develop, tools have also been made for substitute materials, and the company faces 1942 with confidence in its ability to meet conditions.

•

230,000-Volt Line Award

Bonneville Power Administration has awarded a contract to Phelps-Dodge Copper Products Corp., New York, N. Y., at $104,888 for conductor cable and accessories for new 230,000-volt transmission line from Bonneville, Ore., to Vancouver, Wash. (Invitation 2502).

•

Air-Conditioned Cars

Class I railroads and the Pullman Co. had 12,787 air-conditioned passenger cars in operation on January 1, an increase of 587 cars from the same date a year previously, the Association of American Railroads recently announced.

Westinghouse Starts Unemployment Fund

Working on approximately $350,000,000 of war orders, the Westinghouse Electric & Manufacturing Co. has assured its 78,000 employees a "grubstake" for the future when the reconstruction period following the war may result in some layoffs.

The company announced establishment of a special separation reserve fund in which it is setting aside an amount equal to one-half of 1 percent of its payroll each month. This fund will be for the benefit of employees who may be laid off during the change over from emergency war production to normal production.

"Without withdrawing our attention from the present emergency," said W. G. Marshall, vice-president in charge of industrial relations, "it is our responsibility to look ahead to the swing of the pendulum . . ." In addition to setting up a separation reserve for the future, Mr. Marshall said Westinghouse

NAVY MESSAGE TO ADOLF—During ceremonies attendant upon the recent presentation of the Navy "E" pennant to the John A. Roebling's Sons Company, Trenton, N. J., Lieutenant-Commander Warren A. Shaw, U. S. N. Bureau of Ordnance, tossed a finger ring made from a German incendiary bomb into one of the company's open-hearth steel furnaces—"to return it to the Axis powers by the fastest means of transportation known!" The melt of steel into which the ring was thrown will be used by the Roebling company in the manufacture of aircraft control cords and cables for the armament program

IMMEDIATE DELIVERIES CAN BE MADE OF ALBERENE STONE FOR

Alberene Stone Bus Structure and Hothead Compartment, General Electric Company, River Works, West Lynn, Mass.

Compartment Barriers, Bases and Tops for
- **Oil Circuit Breakers**
- **Disconnecting Switches**
- **Bus Runs**
- **Reactors**
- **Regulators**

Panelboards and Switchboards
Low Voltage Bus Bar Supports and Cleats
Bushings

Storage Battery Rooms:
- **Flooring**
- **Shelving**
- **Terminal Blocks and Cleats**

Non-Slip Stair Treads
Cable Entrance Slabs
Removable Pit Covers
Switch, Rheostat and Dimmer Bases

Laboratory Equipment

For more than 40 years the electrical industry has used dense, tough Alberene Stone because of its resistance to flame, spalling, chipping and cracking. It is practically non-absorbent, and has good dielectric strength.

The Stone is easily cut and drilled, and it can be used in relatively thin sections which save space, and copper. Alberene Stone requires no painting and is corrosion-resistant.

Slabs are accurately machined and finished at the Mill according to the design of the engineer and are delivered to the job ready for quick and easy assembly.

Inquiries will have immediate executive attention, and shipments can be made promptly. Alberene Stone Corporation of Virginia, 419 4th Avenue, New York. Sales Offices in Principal Cities. Quarries and Mills, Schuyler, Va.

Alberene Stone
FOR ELECTRICAL CONSTRUCTION

KEEP Your WIRE OFF THE SCRAP HEAP — PRESERVE COPPER —

Splice Those Odd Lengths of Wire The *Nicopress* Way

Now, more than ever, it will pay you to reclaim your short wire lengths and make them available for further service.

There's a mighty easy and economical way to do this job—just splice them with Nicopress Compression Sleeves.

The work is quickly done and the completed splices are small and neat, very little more in diameter than the wire itself. Every Nicopress joint is strong and tight, exceeding the rated breaking strength of the wire.

Order Nicopress Sleeves from your jobber today and start saving by salvaging your short lengths of wire.

Illustrations show ease of making splice and how neatly wire coils after splicing.

THE NATIONAL TELEPHONE SUPPLY CO.
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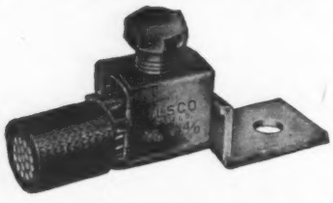
Export Distributor—International Standard Electric Corp., New York N. Y.

ILSCO
SOLDERLESS CONNECTORS

HAVE YOU TRIED The New Ilsco Lugs?



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The new design—as passed by the Underwriters' Laboratories May 1, 1940.

MAIL COUPON TODAY

GENTLEMEN:
SEND ME new Catalog & Sample!

Name .....
Firm .....
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ILSCO COPPER TUBE AND PRODUCTS, INC.
5629 MADISON ROAD — CIN., O.

POLE INSURANCE THAT

Pays Dividends

Osmoplastic groundline treatment increases pole life 7 to 10 years

● Osmoplastic pole treatment is the finest insurance policy for guarding against groundline decay. Simple and easy to apply by your own men, the Osmoplastic treatment adds years to standing pole life thereby reducing costly replacements. It also lengthens the inspection cycle. Service records of over 60 leading utilities prove that Osmose groundline protection pays large dividends annually. Make inspection time Osmoplastic time for low cost pole protection.

OSMOSE WOOD PRESERVING CO.
Bailey Ave. Buffalo, N. Y.
CHICAGO, DENVER, DETROIT, NEW YORK

has also organized its production facilities so that the manufacture of its regular products can be resumed after the war with the "least possible inconvenience to its employees and customers."

•

Refrigerator-Range Sales Rise in '41

Domestic sales of electric household refrigerators during the year 1941 advanced 30.5 percent over the sales recorded for the preceding year, while electric ranges showed a 69.2 percent sales rise, according to figures released recently by the National Electrical Manufacturers Association.

The refrigerator total (domestic) for last year was 3,301,821 units, compared with 2,528,566 units in 1940. Range sales last year amounted to 683,859 units, compared with 404,239 units in 1940.

In December, domestic sales of refrigerators dropped to 91,787 units from 107,176 in December, 1940. Range sales in December, 1941 advanced to 48,705 units from 24,626 in December, 1940, an increase of 97.8 percent.

•

Aids Pan-American Plan

Two of General Electric's Schenectady-made "Excursions in Science" movies have been given Spanish and Portuguese sound tracks and are being distributed in Latin America by the Coordinator of Inter-American Affairs. The films are being distributed as part of the Rockefeller committee's Inter-American relations program.

•

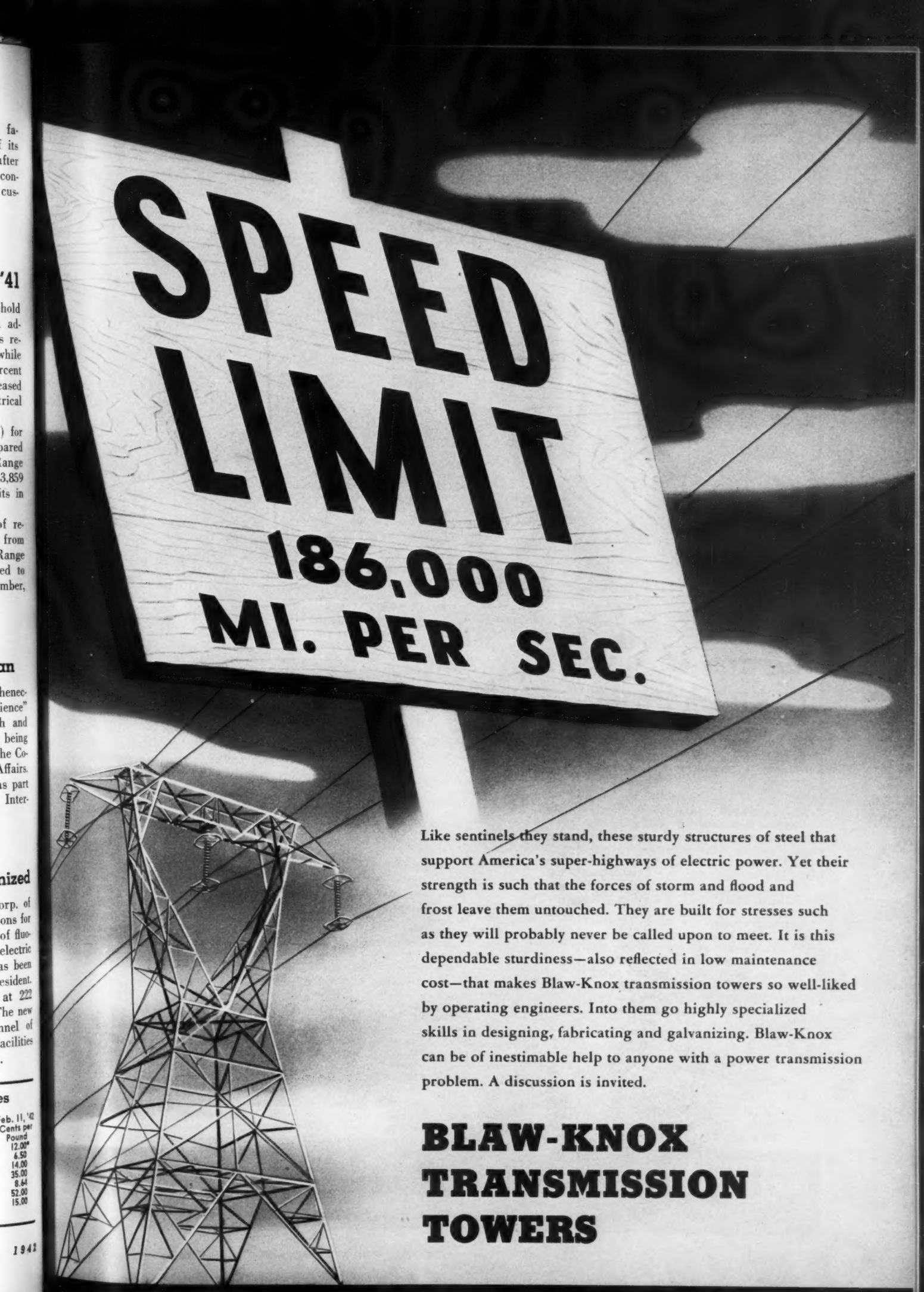
New Company Organized

Formation of the Electric Corp. of America, comprising three divisions for the production and distribution of fluorescent lighting equipment, electric fans, and ice cream freezers, has been announced by L. S. Maranz, president. Plant and offices are located at 222 West Monroe Street, Chicago. The new company combines the personnel of the Lorac Company with the facilities of the Federal Fluorescent Co.

New York Metal Prices

	Feb. 17, '42 Cents per Pound	Feb. 11, '42 Cents per Pound
Copper electrolytic	12.00*	12.00*
Lead, A. S. & R. Price	6.50	6.50
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc, Spot	8.64	8.64
Tin, Straits	52.00	52.00
Aluminum, 99 percent	15.00	15.00

*Delivery Connecticut Valley.

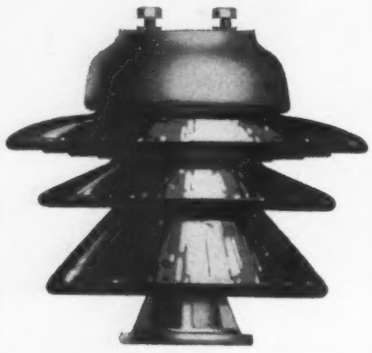


Like sentinels they stand, these sturdy structures of steel that support America's super-highways of electric power. Yet their strength is such that the forces of storm and flood and frost leave them untouched. They are built for stresses such as they will probably never be called upon to meet. It is this dependable sturdiness—also reflected in low maintenance cost—that makes Blaw-Knox transmission towers so well-liked by operating engineers. Into them go highly specialized skills in designing, fabricating and galvanizing. Blaw-Knox can be of inestimable help to anyone with a power transmission problem. A discussion is invited.

BLAW-KNOX TRANSMISSION TOWERS

BLAW-KNOX DIVISION OF BLAW-KNOX COMPANY 2013 FARMERS BANK BUILDING, PITTSBURGH, PA.
NEW YORK • CHICAGO • PHILADELPHIA • BIRMINGHAM

"WINNING FRIENDS WHEREVER LINES EXTEND"



THOMAS
SWITCH AND BUS
INSULATORS

are offered for all voltages up to and including 230 kv. Quiet insulator performance is assured by the use of any Thomas N. E. M. A. Standard or Special unit.

Ask your Switch manufacturer to supply "Thomas Porcelain." It insures longer life and greater stamina to your equipment, and its quiet performance maintains customer goodwill.

OUR 69TH YEAR

Thomas Insulators are backed by 69 years of manufacturing experience. Throughout the march of time and faithful to its tradition of dependability, "Thomas" has given the industry many "Firsts." Most recent is the Thomas patented "Quiet-Type" radio noise-free porcelain insulator. See complete details in Catalog #40.

Write For Your Copy Today

THE R. THOMAS & SONS CO.
LISBON · OHIO

Field Reports on Business

Far-reaching plans are already under way to mobilize the economic potentialities of the entire country for war production. Half-way measures of conversion will be a modus operandi of the past, judging from present indications. Larger orders for electrical equipment are still being placed by the government.

NEW ENGLAND

New Bedford Edison is seeking permission to build a 20-mile, 110-kv., single-circuit, H-frame interconnection with the Montaup Electric system at an estimated cost of $1,093,300. Industrial production is accelerating sharply and running about 15 percent ahead of a year ago.

Motor-generator sets are in urgent demand; requirements for naval and merchant marine ships building in this district are vital and every effort is being bent to make short time deliveries. Large orders for ventilating and air-conditioning apparatus for cargo carriers were recently closed by manufacturers in this district. Wire and electric cable manufacturers are operating at full capacity and have bid on a $3,500,000 government schedule released a short time ago. Insulated wire orders running up to over $15,000 have been received lately.

Waltham Watch Co., Waltham, Mass., has installed an 11.75-kw. infra-red unit for drying bezels. Orders for small switches are steady and electric automatic control apparatus is moving at a good pace.

B. F. Sturtevant Co., Hyde Park, Mass., will supply a cooling and air-conditioning system for Firestone Rubber & Latex Products Co., Fall River, Mass. Special fans and air-conditioning apparatus will be supplied by Sturtevant to a United States Rubber Co. factory at Bristol, R. I. Construction of 600 housing units in the Greater Boston area to serve workers at Bethlehem Steel's Fore River shipyard and other defense plants will be started early in the spring.

Appliance dealers report a marked eagerness to buy major appliances. Stocks are being rapidly depleted in northern New England areas. A group of Vermont central stations sold 124 refrigerators and 56 ranges in January.

PACIFIC COAST

On the whole, Pacific Coast and Salt Lake City stocks are good, with fairly steady replacements, but lines available only for high priorities are steadily increasing, thus constantly narrowing the field of sale. Some good shipments of major appliances have been received, but merchandising organizations are being cut to conform with predicted April freezing. Seattle is in the market for 1,250 each 6-cu.ft. refrigerators, ranges and 30-gal. water heaters for two housing projects.

County and small municipality housing is increasing, making a better distribution of contracts; $158,942 was the electrical contract for Aliso housing in Los Angeles, an unusually good electrical proportion, the basic bid being $2,075,000 for 800 family units. Electrical buying by municipalities is unusually good, such as $130,900 by Los Angeles for auxiliary electrical service building, and switchgears and circuit breaker purchases by nearby cities of Glendale and Burbank; annual contracts for bare and weatherproof copper wire and $100,000 of distribution transformers by Tacoma and three 1,500-kva. transformers by Portland in the Northwest. New Naval projects cover a $2,000,000 Naval air training station near Livermore, just southeast of Bay area, and a planned $15,000,000 development at Treasure Island, site of San Francisco's 1939-'40 exposition.

Recent orders of varied interest cover $120,000 G.E. switchgear equipment to a Kaiser steel plant; $415,350 for three electric gantry cranes for Hawaiian Islands; 5 miles No. 4/0 copper trolley wire for San Francisco; $121,802 to Wolfe and Mann for station distribution equipment for Grand Coulee; $47,955 to Pacific Electric Manufacturing Co. for breakers for Longview substation, and $67,942 for 440,000 lb. bare and weatherproof copper cable for Bonneville system.

NEW YORK

That the government is aware that nothing short of an all-embracing shift in the country's economic structure to war production will be sufficient to win the war is evidenced by the steps now being taken to curtail durable consumer goods production. Action taken by WPB on radios and refrigerators indicates that the same drastic measures will undoubtedly follow in other lines.

Engineering construction last week, $104,893,000, topped the $100,000,000 mark for the fourth consecutive week. This volume, however, was 35 percent below the total for the preceding week as reported by *Engineering News-Record*. The week's volume brought 1942 construction to $894,763,000, an increase of 15½ percent over the total for the opening seven-week period last year.

Merchants in the metropolitan area report that retail trade showed larger increases last week than in the preceding week. Department store volume was estimated as advancing about 20 percent over the corresponding week last year.

CHICAGO

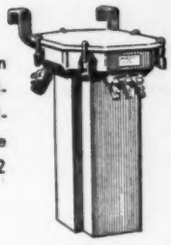
Manufacturing activities are reflecting the increasing momentum of the war production program in transforming civilian economy to a complete war footing. Each week is bringing a further reduction in the operations of civilian goods industries and added force to the flow of armament production.

This augmented war effort has raised the demand for nearly all types of electrical equipment. In addition to the large orders from the army and navy, requirements for equipment in new and enlarged plants are extremely heavy. Utilities are making strenuous efforts to speed construction of new generating facilities to meet the rapidly increasing demand for power. Most load building promotional efforts are being curtailed. Allowances for electric range installations have been reduced or stopped altogether in areas where the industrial demand is rapidly reducing reserve capacity.

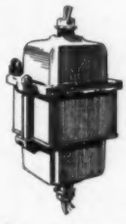
Since Chicago has been designated as a defense area, several large housing projects, involving 1,804 dwelling units, have been approved for completion at a cost of approximately $12,000,000. Residential construction, other than low-cost defense housing, has fallen off to a negligible amount.

AS THE DOCTOR PRESCRIBES . . .

AmerTran power transformers available for all requirements in sizes to 10,000 KVA. 132 KV.



AmerTran distribution transformers of either oil- or noninflammable-liquid-immersed type available in sizes to 500 KVA., 72 KV.



AmerTran air-cooled transformers for either indoor or outdoor service are available for all industrial requirements—sizes to 150 KVA.

• Just as the skilled pharmacist compounds the drugs called for by the doctor's prescription . . . so AmerTran's skill, experience and facilities combine to produce Transformers that exactly meet *your prescription* (specification). AmerTran Transformers are engineered mechanically and electrically to render dependable service . . . they can also be designed specifically to meet your particular requirements and conditions. For more than 40 years AmerTran has supplied to all branches of industry all types of transformers regularly required. This equipment is manufactured in sizes up to 10,000 KVA., 132 KV., and in large or small quantities. Let us quote on transformers for your needs.

AMERICAN TRANSFORMER CO., 178 Emmet St., Newark, N. J.

Manufactured Since 1901 at Newark, N. J.

AMERTRAN

Built to your Specifications

COHARDITE
INSULATED TOOLS

Reduce accidents and service interruptions

#21 Socket Wrench
List Price $1.25

An ideal meterman's tool that will greatly reduce the possibility of damage through short circuits caused by the tool. Walden Worcester Spintite type forged and tempered steel blade, hardened socket. COHARDITE insulated to the socket head. Available in 5/16", 3/8", 7/16" and 1/2" hex nut size.

Every tool tested to its full rated dielectric strength of 20,000 volts for one minute RMS before it leaves our plant.

A full range of COHARDITE insulated small tools carried in stock for meter and distributor departments.

Send for a catalog

The Connecticut Hard Rubber Co.
408 East Street, New Haven, Conn.

Acme BIAS Tapes HAVE EXTRA GOOD Stretch

EASIER BETTER WORK!

They fit as smoothly into corners as though "poured" in! Their great flexibility and tensile strength are due to Acme factory-tested varnishes, highest grade cotton, careful processing and inspection. Tapes, bias and straight; rolls to 36" wide. Yellow or black; choice of finishes. Samples on request.

THE ACME WIRE CO., NEW HAVEN, CT.
ACME WIRE PRODUCTS
VARNISHED INSULATIONS
MAGNET WIRE COILS

Manufacturers Make Sales Appointments

Sales assignments have recently been announced by the following manufacturing companies:

Okonite Company has announced the appointment of Otis W. Herring and William D. Stroud to the staff of the Birmingham office as sales engineers. Mr. Herring, who will be located at the company's office in the Comer Building, Birmingham, will handle Tennessee and the northern portion of Alabama and Mississippi. Mr. Stroud, formerly a distribution engineer with the Georgia Power Co., will cover Louisiana and the Gulf Coast area of Florida, Alabama and Mississippi. L. L'Heureux and W. H. Hammond have joined the staff in Atlanta, Mr. L'Heureux handling the Florida territory from his home at 2360 St. Johns Avenue, Jacksonville. Mr. Hammond will be located at 2538 Kenmore Avenue, Charlotte, N. C.

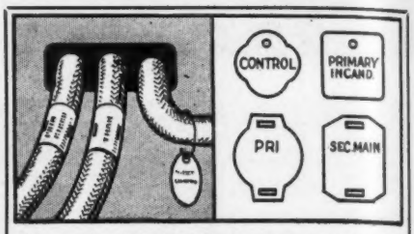
Airtemp Division, Chrysler Corp., has named Dewey H. Dolison district manager in the Chicago territory, and William Kearney, district manager in the Dallas, Tex., territory. Mr. Dolison has had extensive experience in the air-conditioning field and during recent years has worked with the General Electric Co. Mr. Kearney has been sales representative for Universal Cooler Corp. in recent years.

Corning Glass Works, Corning, N. Y., has announced the appointment of the George Hamburger Co., 226 Cooper Building, Denver, Colo., to represent the company in the state of New Mexico, in addition to covering the previous territory, which includes all of the state of Colorado, that part of the state of Wyoming lying east of a prolongation of the Utah-Colorado boundary line, and that part of the state of Nebraska lying west of 102 deg. longitude. W. D. Howze & Co., 912 East Third Street, Los Angeles, will represent Corning Glass in the state of Arizona in addition to the previous territory which includes that part of the state of California lying south of 35 deg. latitude and Clark and Nye counties in Nevada.

Lincoln Electric Issues War Subjects Procedure

Procedure for handling papers on war subjects for submission to the James F. Lincoln Arc Welding Foundation in the $200,000 Industrial Progress Award Program has been announced by the officials of the foundation. The Progress Program closes June 1. The program offers 458 awards ranging from $100 to $13,700 for papers describing advances and improvements resulting from the various application of arc welding.

In making the announcement, the foundation expressed the belief that many persons whose work is involved in the war effort, and whose choice of subject matter for papers is limited to war equipment, may be missing participation, whereas they might be enabled to participate by following the procedure suggested.



Berry Electric Cable Markers eliminate mistakes and costly accidents.

Berry's non corrosive alloy markers for underground cables eliminate confusion in identification. Type of cable is readily distinguishable by size and shape of marker. Immediately available in stock patterns. Send for free catalog CM-10.

Wm. B. Berry Co., 88 North St., Boston, Mass.

HIGH GRADE HARD PORCELAIN FOR Electrical Specialties
High and Low Voltages

IMPERIAL PORCELAIN WORKS
TRENTON, NEW JERSEY

ACE of PLUGS!

COLOR TELLS SIZE
EASY SELECTION
QUICK INSPECTION

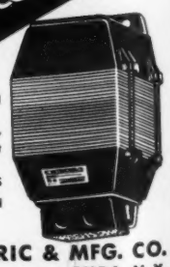
The shock and vent-proof top is safe—no glass to cut fingers—and their dependability means less loss of revenue.

"YOU CAN'T GO WRONG WITH COLORTOPS"

TRICO FUSE MFG. CO. Milwaukee, Wis.

TRANSFORMERS BY Acme

SEND FOR BULLETIN



- AIR COOLED; standard industrial and P. F. correction.
- MERCURY VAPOR High Intensity Lamp; for industrial and daylight flood lighting.
- FLUORESCENT LAMP BALLASTS
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THE ACME ELECTRIC & MFG. CO.
43 WATER ST. CUBA, N.Y.

Acme ACME Electric

++++++++++++++++++++++++++++

Why your Red Cross urgently needs

FIFTY MILLION DOLLARS, NOW

How the fund is allocated . . . What it does in service

Every dollar that you give now to your Red Cross marches into the thick of things where humanitarian help is needed most—up to the fronts and battle stations where the fighting is heaviest. Into the Red Cross hospitals and First Aid units where prompt medical attention and supplies may save innumerable lives. And throughout our broad land to train and equip volunteers to meet any emergency that may strike.

How the $50,000,000 War Fund is Used

SERVICE TO THE ARMED FORCES • • • • • • $25,000,000

Provides for the care, welfare and morale of the Army and Navy, including services to men in hospitals and during convalescence. • Provides an important link between the service men and their families; keeps the families from breaking up, supplies food, shelter, medicine, and even jobs where necessary. • Provides essential medical and other supplies outside of standard Government equipment. • Operates Red Cross headquarters at camps and naval stations. • Enrolls blood donors and medical technologists for Army and Navy needs. • Provides millions of surgical dressings, sweaters, socks, etc. through volunteer workers.

DISASTER AND CIVILIAN EMERGENCY RELIEF • $10,000,000

Supplies emergency needs for food, clothing, shelter and medical attention for disaster victims. • Assists stricken families in repair of homes and other adjustments; provides minimum reserves of essential relief supplies to prevent unnecessary delays.

CIVILIAN DEFENSE SERVICES • • • • • • • • $ 5,000,000

Trains volunteers for home nursing and nurses' aides. • Trains nurses, men and women, for active duty with the Army and Navy. • Trains volunteers in First Aid and accident prevention. • Trains volunteers for work in Motor Corps, Canteen and Production. • Instructs men, women and children in preparedness against explosive and incendiary bombs. • Organizes for evacuation of children and their families from stricken areas. • Assists Red Cross Chapters in establishing effective coordination of emergency relief with local and State defense authorities.

SERVICE AND ASSISTANCE THROUGH CHAPTERS • $ 4,000,000

Gives assistance and service to the 3,740 Red Cross Chapters with their 6,131 Branches responsible for local Red Cross activities, particularly welfare work among the service men and their families.

OTHER ACTIVITIES AND CONTINGENCIES • • • $ 6,000,000

Provides for unforeseen expansions in program and for new activities made necessary by unexpected developments.

TOTAL • • • • • • • • • • • • • • • • • $50,000,000

THE AMERICAN RED CROSS $50,000,000 WAR FUND

Note to Red Cross Canvassers: Use the material on this page to better inform contributors how their donations are being expended.

This space contributed to The American Red Cross by ELECTRICAL WORLD

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YOUR
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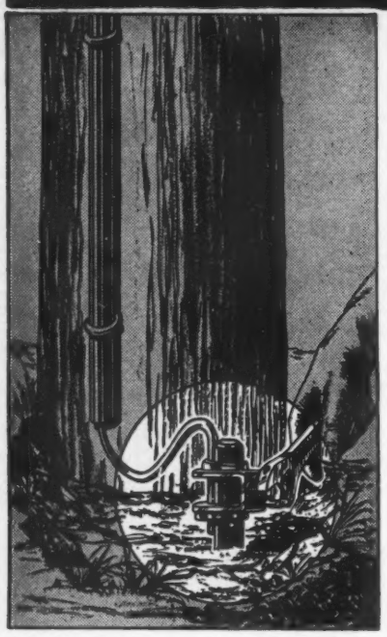
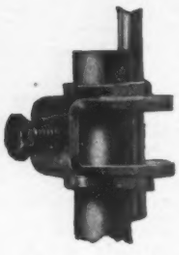
PRACTICE—





RELIABLE
GROUND
ROD
CLAMPS

Still out
in front

The first low price efficiently designed Ground Rod Clamp still offers a fine thread screw to apply a really high pressure joint, Everdur material throughout, and a body that springs slightly under stress so it will not vibrate loose. Hollow head set screws when specified.

Reliable
ELECTRIC COMPANY
OVER 30 YEARS SERVICE TO THE UTILITIES
3145 CARROLL AVENUE · CHICAGO ILLINOIS

Sales Opportunities

JOHNSON CITY, N. Y.—New York State Electric & Gas Corp., Ithaca, N. Y., has approved plans for addition to Westover steam-electric generating station at Johnson City, and will begin work soon on superstructure. Additional equipment will be installed for increased capacity. No estimate of cost announced.

DETROIT, MICH. — Vickers, Inc., 1400 Oakman Boulevard, manufacturer of hydraulic pumps, valves, etc., plans installation of motors and controls, electric conduit, transformers and accessories, switchgear, fluorescent lighting system, power wiring, conveyors and other equipment in new plant on Eight-Mile Road, near Greenfield Road, vicinity of Detroit. It will comprise a main one and multi-story unit and auxiliary structures, to be equipped for production for government. Cost about $3,500,000, with financing in that amount to be provided by Defense Plant Corporation, Washington, D. C. Austin Co., Inc., 16112 Euclid Avenue, Cleveland, Ohio, is architect and engineer.

LEXINGTON, NEB.—Dawson County Public Power District, Lexington, plans extensions in primary and secondary lines in parts of Dawson and neighboring counties, totaling about 90 miles, with service facilities. Work is scheduled to begin soon. Application has been made for permission.

GRAND COULEE, WASH. — Bureau of Reclamation, Denver, Colo., receives bids until March 3 for ten 36,000-kva., 60-cycle, single-phase, oil-immersed, water-cooled transformers, 13.6-13.8/230 Y kv., for units L-7 to L-9, inclusive, and for one similar spare transformer for use with any unit, for Grand Coulee hydroelectric power station, Columbia Basin project, Wash. Equipment will be installed by government (Specifications 1025).

HARVEY, N. D.—Otter Tail Power Co., Fergus Falls, Minn., plans extensions in steam-electric generating station in vicinity of Harvey, including installation of new 5,000-kw. turbine-generator unit and accessories. Proposed to carry out work at early date, to have equipment ready for service in November. Also plans new transmission from station to Rugby, N. D. This is part of 1942 expansion program of company.

LOCUST GROVE, OKLA. — United States Engineer Office, Wright Building, Tulsa, Okla., has called public hearing at Pryor, Okla., in connection with new power and flood control dam on Grand River, at Markham Ferry, vicinity of Locust Grove, and proposes to begin work on project at early date. Dam will be about 90 ft. high, with crest length of approximately 3,900 ft., designed to create a storage reservoir of about 187,000 acre-ft. Details of generating station and equipment installation will be determined soon. Entire project is estimated to cost about $14,000,000, with initial appropriation of $1,500,000 now available.

ADAMS, MASS.—New England Lime Co., Adams, manufacturer of hydrated lime and kindred products, plans installation of motors and controls, transformers and accessories, switchgear, electric conduits, power wiring, industrial lighting system, conveyors and other equipment in new plant for production of metallic magnesium for government. It will comprise several one and multi-story buildings, equipped for rated output of about 7,500,000 lb. per annum, and will be located on site in vicinity of Adams, or Canaan, Conn., where company operates a branch works. A power substation and boiler plant will be built. Entire project will cost approximately $2,500,000, with financing in that amount to be provided by Defense Plant Corporation, Washington, D. C. Work is scheduled to begin soon.

YOUNGSTOWN, OHIO — Republic Steel Corp., Republic Building, Cleveland, Ohio, plans new steam-electric generating station at branch steel mill at Youngstown, where expansion will be carried out for production for government, to include turbine-generator unit and accessories, boilers and auxiliary equipment. Cost reported over $2,000,000. United Engineers & Constructors, Inc., 1401 Arch Street, Philadelphia, Pa., is engineer and will supervise construction.

PORTLAND, ORE. — Purchasing Officer, Bonneville Power Administration, Department of Interior, Guardian Building, Portland, receives bids until March 6 for five 35,000-kva. outdoor-type synchronous condensers, for use at various points (Invitation 2595).

DEARBORN, MICH. — Ford Motor Co., Dearborn, plans installation of motor-generator sets, heavy-duty motors and controls, transformers and accessories, switchgear, electric conduit, power wiring, fluorescent lighting systems, electric hoists, electric cranes, conveyors and other equipment in new additions to River Rouge plant, comprising a one-story building, about 230 x 1,100 ft., for armor plate manufacture, estimated to cost over $3,500,000; and one-story structure, approximately 100 x 440 ft., for expansion in steel mill, to cost over $1,000,000. Erection will be placed under way soon. Shreve, Anderson & Walker, Marquette Building, Detroit, Mich., are architects for first noted building; and Giffels & Vallet, Inc., last noted address, architect and engineer for steel mill extension.

KANSAS CITY, KAN.—Board of Public Utilities, Sixth Street, Charles A. Lowder, secretary, receives bids until March 4 for power piping installation in addition to municipal power plant. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

BOULDER CITY, NEV. — Bureau of Reclamation, Denver, Colo., receives bids until March 2 for following equipment for Nevada State switchyard and Boulder City power substation, Boulder Canyon project, Arizona-California-Nevada: Four 6,667-kva., 60-cycle, single-phase, 66,000 Y to 2,300 delta-volt, oil-immersed, self-cooled, outdoor-type transformers; two 69,000-volt, 600-amp., three-pole, single-throw, manually gang-operated, horizontal-upright-mounting, outdoor-type disconnecting switches, with manually gang-operated grounding blades; three 7,500-volt, 5,000-amp., single-pole, single-throw, hook-stick-operated, vertical-mounting, outdoor-type disconnecting switches; two 69,000-volt, three-phase, station-type lightning arresters; one 69,000 to 115-volt, three-phase, 60-cycle, oil-immersed, self-cooled, outdoor-type metering equipment. All equipment will be installed by government (Specifications 1026).

HASTINGS, NEB.—Central Nebraska Public Power and Irrigation District, Hastings, has plans maturing for extensions in primary and secondary lines in parts of Dawson and Gosper counties, totaling close to 20 miles, with service facilities. Permission has been secured and work will be placed under way soon.

Puget Theatre Plays to Packed Houses

Dedicated to the national defense theme, the Puget Sound Power & Light Co.'s participation in the recent Western Washington Fair took the form of a Little Theatre that played to packed houses. The company display consisted of two central themes, one being a modern home, attached to which was a completely electrified conservatory; the second was this little theater, built entirely of plywood.

With a seating capacity of 120, the theater put on 20-performances a day, with standing-room-only signs out most of the time. The total attendance was about 20,000. The presentation took the form of a series of electrical experiments, including cooking a meal in a frying pan on top of a newspaper; making a steel bar white hot by immersing it in a jar of water, the village blacksmith experiment; production of cold light, with "light cocktails," and production of black light.

As assistants, the master of ceremonies employed the services of the home service girls of the company, dressed in sports outfits made of fluorescent satin, so that, under the influence of the black light, they seemed to the audience to leap into life.

•

Pit River Hydro Project Applications Filed

Federal Power Commission has announced its determination that the construction and operation of a new power development on the Pit River in Shasta County, California, by the Pacific Gas & Electric Co., designated by the company as its Pit 5 plant, is within the ambit of federal authority and will require a Federal Power Commission license.

In an opinion issued with the determination, the commission found that the proposed Pit 5 plant will affect the interests of interstate commerce on the Sacramento River and will also affect lands of the United States due to the close relationship between the new development and the company's Pit 3 and Pit 4 plants.

Pacific Gas & Electric filed an application last week with the FPC for the new project.

•

44-Hour Week for FPC

Chairman Leland Olds has advised all departmental and field employees of the Federal Power Commission of the establishment of a 44-hour workweek, effective January 26, to expedite the commission's war-time activities.

Subox and Subalox Anti-Corrosive Paints are now made in New Non-Reflective

PROTECTIVE CONCEALMENT COLORS

for Immediate and Spring Delivery. Write for new Color Card.

Subox, Inc., North Arlington, N. J.

STATES TESTING EQUIPMENT

METER TEST DEPARTMENTS

Asked for it — Here it is — A Specially designed Test Table built around the

New Photo-Electric Watthour Meter Tester

Form FRD Cat. No. 11246

This equipment provides at least two big advantages:—

Improved Accuracy and Saving in Testing Time.

A light beam and relays count the revolutions of the meter under test and automatically start and stop the test meter.

Reduces Running Time. The inherent accuracy of this Test Equipment makes long running time unnecessary. Repeat runs frequently made in the past to be sure that proper readings were obtained are, of course, unnecessary.

Write for new catalog describing this completely new Test Table.

Tear Off and Mail Today

To THE STATES COMPANY
Hartford, Conn.

Please send description of the new Form FRD Test Table.

Am particularly interested in.....

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THE STATES COMPANY 3 New Park Ave Hartford, Conn

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

10 cents a word, minimum charge $2.00.

(See ¶ on Box Numbers.)

POSITIONS WANTED (full or part-time salaried employment only), ½ above rates.

PROPOSALS, 50 cents a line an insertion.

INFORMATION:

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

The advertising rate is $6.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. E.W.

NEW ADVERTISEMENTS received by 10 A. M. March 2nd will appear in the March 7th issue subject to limitations of space available.

POSITION VACANT

ELECTRICIAN FOREMAN for Industrial Construction experienced transformers, O.C.B., generators, large motors and switchboards. Applicant must be capable of directing several gangs of electricians. Needed at once. Job located in deep South and good for about one year. P-34, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 32 years' recognized standing and reputation carries on preliminary negotiations for positions of the calibre indicated above through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If your salary has been $2,500 or more, send only name and address for details. R. W. Bixby, Inc., 262 Delward Bldg., Buffalo, N. Y.

EXECUTIVES AND TECHNICAL MEN. Qualified candidate desiring $2,500 to $20,000 position may contact employers through our confidential services, established 26 years. The National Business Bourse, 20 W. Jackson Blvd., Chicago.

POSITIONS WANTED

MANAGER (Draft exempt). Twenty years successful experience both large and small organizations. Electric, gas, water, heating, ice, merchandise. Steam, hydro, oil engine plants. Public relations, load building, construction, present day problems, etc. Accustomed to full charge of operations, or as district manager. Many years present connection. Present conditions make change desirable soon. References. Let me handle your toughest situation. PW-26, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

GRADUATE MECHANICAL - ELECTRICAL ENGINEER with 25 years experience in responsible positions with public utility and large manufacturing companies. Have been in charge of planning and designing complete projects including purchase and installation of equipment, letting contracts, supervising construction and maintaining plants in operation. PW-28, Electrical World, 68 Post St., San Francisco, Cal.

WANTED

ANYTHING within reason that is wanted in the field served by Electrical World can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

MOTORS

1—200 HP Westinghouse Motor, Slip Ring, Type M.W. 440 V, 60 cy, 3 ph, amp 275, 580 TPM, with controlls and base.

1—50 HP Vertical, G.E. Motor, 3 ph, 60 cy, 440 V. 66 amps, 750 RPM, Type 4-1 with starting box.

1—Otis Elevator 52 HP Motor, 440 V, 3 ph, 60 cy, 81 amps, Type 10, Size 65, 750/240 RPM, A.C.

DAYTON STEEL AND MACHINERY COMPANY

303 Keowee Street, Opposite Valley St.
DAYTON, OHIO

FEED WATER HEATER

Hoppes exhaust steam feed water heater, class R, size E, cast iron construction, 5000 HP, working press. 10 lb. per sq. inch gauge.

BOILER FEED PUMP

1—Worthington, size 12" x 7½" x 15", 300 lb. water pressure, 175 lb. steam pressure, brass bushed stuffing boxes and glands, duplex plunger type.

FS-33, Electrical World
520 N. Michigan Ave., Chicago, Ill.

WANTED

—TRANSFORMERS—

TRANSFORMERS WANTED

in operating condition or burnt out. Mail us list giving complete nameplate data and stating condition.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
Write for Catalog No. 136-A

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI, OHIO

METERS WANTED

35 rebuilt meters 110 volt 60 cycle single phase house sizes and 5 220-volt 3 phase for submetering for accounting purposes. Can use three dial.

GEO. P. SMITH, JR.
AURORA, OHIO

Your inquiry will have special value . . .

if you mention this magazine, when writing advertisers. Naturally, the publisher will appreciate it . . . but more important, it will identify you as one of the men the advertisers wants to reach with his message & help to make possible enlarged future service.

Searchlight Can Help You!

HUNDREDS of miscellaneous business problems that confront you from time to time, can be quickly and easily solved through the use of the Searchlight Section of this or other McGraw-Hill publications.

The Searchlight Section is the classified advertising appearing in each of these papers. Use it at small cost, to announce all kinds of business wants of interest to other men in the fields served by these publications: when you want additional employees, want to buy or sell used or surplus equipment, want additional products to manufacture, seek additional capital, or have other miscellaneous business wants.

Departmental Staff, **McGRAW-HILL PUBLISHING CO., Inc.**
330 West 42nd Street, New York City

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Business Week	Bus Transportation
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Electrical Merchandising	Electrical World
Electronics	Engineering and Mining Journal
Engineering News-Record	E. & M. J. Markets
Factory Management and Maintenance	Food Industries
Power	Product Engineering
Textile World	Transit Journal